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Fact Sheet for the Ranking Minority Member, Subcommittee on Energy, Nuclear Proliferation, and Government Processes, Committee on Governmental Affairs, U.S. Senate

November 1985

ENVIRONMENT, SAFETY, & HEALTH

Information on Three Ohio Defense Facilities

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UNITED STATES GENERAL ACCOUNTING OFFICE
WASHINGTON, D.C. 20548

RESOURCES, COMMUNITY,
AND ECONOMIC DEVELOPMENT
DIVISION

B-221188

November 29, 1985

The Honorable John Glenn
Ranking Minority Member
Subcommittee on Energy, Nuclear
Proliferation, and Government Processes
Committee on Governmental Affairs
United States Senate

Dear Senator Glenn:

On April 15, 1985, you asked us to review the Department of Energy's (DOE) effectiveness in protecting its workers, the community, and the environment at three defense production facilities in Ohio. These facilities are the Feed Materials Production Center at Fernald, Portsmouth Uranium Enrichment Complex at Piketon, and Mound at Miamisburg. As agreed with your office, we are providing you details on the Ohio plants in the enclosed fact sheet that consists of three appendices--one for each plant--and will provide you an overall evaluation of the plants and other issues shortly.

The three Ohio plants must meet and comply with numerous regulations, procedures, and standards to minimize environmental degradation and worker safety and health impacts from their operations. For the last 5 years, contractor records indicate that the plants have complied with DOE's radioactive air emission and water release standards. However, each plant has environmental problems unique to its specific operation. DOE is in the process of correcting or taking actions to address these problems.

Over the 30 years the three plants have operated, numerous employees have been exposed to radioactive and nonradioactive substances. Most exposures have been within prescribed DOE standards. For example, Fernald's employee exposure records show that since beginning operations in 1952, only 1 employee exceeded DOE's standards; Portsmouth reported that 8 employees had exceeded DOE's standards in 1965; and Mound reported that 17 employees exceeded DOE's standards between 1960 and 1979.

To obtain the facts presented, we interviewed (1) DOE officials from headquarters; the Oak Ridge, Tennessee, and Albuquerque, New Mexico, Operations Offices; and the Dayton,

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Ohio, Field Office; (2) contractor management and environmental protection staffs at each plant; (3) U.S. Environmental Protection Agency (USEPA) headquarters and Region V officials; (4) officials from the Ohio Attorney General's office, Ohio Environmental Protection Agency, and Ohio Department of Health; (5) local officials in the communities around the three plants; and (6) union representatives from each plant and two consultants who provide health and safety advice to the unions at Fernald and Portsmouth. We also reviewed various legislation and numerous reports by DOE, Ohio, and USEPA.

As arranged with your office, the facts presented were discussed with the contractors of the three plants, DOE headquarters and field office officials, and USEPA headquarters officials. Unless you publicly announce its contents earlier, we do not plan to distribute this fact sheet until 30 days from its issue date. At that time we will send copies to DOE, officials of the three Ohio plants, and other interested parties upon request. If you have any questions regarding the fact sheet, please call me at (202) 275-8545.

Sincerely yours,

Keith O. Fultz
Associate Director

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ABBREVIATIONS

ACGIH	American Conference of Government Industrial Hygienists
ALARA	as low as reasonably achievable
CEARP	Comprehensive Environmental Assessment and Response Program
DOE	Department of Energy
EMD	Energy and Minerals Division
ES&H	environment, safety, and health
NIOSH	National Institute of Occupational Safety and Health
NPDES	National Pollutant Discharge Elimination System
Ohio EPA	Ohio Environmental Protection Agency
ORAU	Oak Ridge Associated Universities
OSHA	Occupational Safety and Health Administration
PCB	polychlorinated biphenyl
RAPCA	Regional Air Pollution Control Agency

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RCED	Resources, Community, and Economic Development Division
RCRA	Resource Conservation and Recovery Act of 1976
rem	roentgen equivalent man
TLD	thermoluminescent dosimeters
USEPA	U.S. Environmental Protection Agency

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PROGRAMS TO PROTECT THE ENVIRONMENT AND WORKER HEALTH AND SAFETY AT FERNALD

The Feed Materials Production Center located at Fernald, Ohio, near Cincinnati, has been a key element in DOE's weapons production system since it began operating in 1952. It produces various uranium metal forms; the metal is processed into fuel cores and elements that are used in government reactors to generate electricity and produce plutonium for weapons. Fernald covers 1,050 acres of land and employs about 1,200 people. At the time of our review, NLO, Inc., a subsidiary of NL Industries, had operated the plant since it opened. However, on September 24, 1985, DOE announced that Westinghouse Electric Corporation would operate the plant beginning in 1986.

DOE's Oak Ridge Operations Office oversees contractor operations at Fernald. The Oak Ridge Environmental, Safety, and Health Division oversees the contractor's environmental, safety, and health performance in part through appraisals. The appraisals are designed to assess the contractor's performance in meeting DOE's environmental, safety, and health (ES&H) objectives. Oak Ridge conducts different types of appraisals in the ES&H area as part of a contractor award fee process. The appraisals are generally conducted annually. To provide better oversight and coordination, Oak Ridge in February 1985 opened a site office at Fernald with two people. Prior to that time Oak Ridge provided oversight functions through periodic visits; this practice will be continued in conjunction with the on-site activities.

During the 1970's DOE considered closing Fernald because of reduced demand for its products. While DOE debated the shutdown, capital improvements were not made, much of the equipment and production technology became obsolete, and the number of employees was reduced. However, increased production demand since fiscal year 1981 has put a strain on the plant and its management, according to DOE officials. Oak Ridge established a task force in April 1984 to review, among other things, Fernald's operations and assess its capability to meet production goals. In its June 1984 report the task force noted that Fernald overemphasized production, making environmental and worker safety and health secondary concerns. The task force went on to say that

> "this attitude of production first still permeates the organization and a need exists to promote a more balanced view of the importance of all requirements facing the facility."

Similar concerns were also expressed by an Oak Ridge team that investigated Fernald's September 11 to December 7, 1984, releases of about 273 pounds of slightly enriched uranium to the air. The team noted Fernald's overemphasis on production

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goals. One of the recommendations in the team's February 1985 report stated that

> "the total management of environmental, safety, health, and quality assurance programs at [Fernald] should be scrutinized carefully and changed accordingly to reflect a more equitable balance between production needs and environmental, safety, and health concerns."

In fiscal year 1985, DOE started a $382 million to $482 million program to modernize Fernald's production facilities and equipment and improve its environmental protection and worker safety programs. DOE officials estimate it needs $182 million over the next 7 years for new process technologies and equipment to modernize Fernald's production facilities to meet increasingly stringent radiation and industrial safety requirements and between fiscal years 1987 and 1994 between $200 million and $300 million for ES&H improvements.

FERNALD REPORTS SHOW IT MEETS ENVIRONMENTAL STANDARDS BUT SOME DEFICIENCIES ARE IDENTIFIED

Fernald processes radioactive materials that generate radionuclides (radioactive particles) in dust, water, and waste. These radionuclides include insoluble uranium, small quantities of plutonium, and radon. The dust can escape the plant site in the air or be comingled with surface water runoff. Further, radioactive waste stored in pits can leak into the air and water.

According to its reports, air releases are the predominant pathway by which Fernald releases radioactivity. While the 1980-1984 annual environmental reports prepared by Fernald show that its radioactive air emissions were below DOE's exposure standards for people living around the plant, Oak Ridge, the U.S. Environmental Protection Agency (USEPA), and Ohio have questioned the accuracy of the data.

In addition, a consultant's report shows that inadequate control of surface water runoff may have resulted in uranium contamination in three off-site wells--including one used for drinking water. The contamination is within DOE's guidelines, and Fernald officials do not believe that the plant's operations have had an adverse impact on the community's drinking water aquifer. Fernald is also monitoring on-site wells for possible contamination and a waste disposal pit for possible migration (movement) of nuclear materials. In 1984 Fernald found two on-site wells contaminated with radioactive substances as high as 90 percent of DOE's guidelines and chemical contamination significantly above Ohio Environmental Protection Agency (Ohio EPA) standards. As a result of these problems, DOE is funding air, water, and waste pollution improvements to enhance future environmental controls.

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APPENDIX I

Various studies found that Fernald's air emissions contaminated the environment

DOE has had air emission standards since 1946. Its standards until February 1985--0.5 rem[1] for the whole body and 1.5 rem for the critical organ--took effect in 1960. In February 1985 USEPA set much lower limits of 0.025 rem for the whole body and 0.075 rem to the critical organ; and Fernald instituted various administrative and operating controls, such as installing additional stack monitors, to bring its air releases into compliance with USEPA's standards. DOE requires Fernald to monitor air emissions and compare them to USEPA's standards to determine whether adequate radiation protection is provided for the environment. Fernald continuously gathers emission data from numerous exhaust stack samplers (probes placed in the stack to extract air samples) and seven air monitors located about equidistant from each other around the plant's boundary.

Between 1980 and 1984 Fernald's reports showed that airborne releases were within DOE's standards. However, DOE's reports showed that between 1980 and 1983 the plant had the second or third highest dose of any DOE plant and in 1984 it had the highest dose even though it processed, according to a DOE official, some of the least radioactive material of any DOE facility. In addition, several questions have been raised about the accuracy of Fernald's reported statistics and the resulting impact of its operations on the public. For example,

--several groups have questioned the location of Fernald's air sampling monitors, reliability of the equipment, and validity of the data produced;

--uranium-contaminated soil has been found on- and off-site near the plant's boundary; and

--Fernald does not have a program to keep radiation released to the environment and exposures to the public as low as reasonably achievable (ALARA).

Reliability of air emission data questioned by Oak Ridge, USEPA, and state

Oak Ridge, USEPA, and state officials have questioned the reliability of Fernald's air monitoring system and reported release data. In June 1984 an Oak Ridge appraisal noted that

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[1]Roentgen equivalent man (rem) is the dosage of an ionizing radiation that will cause the same biological effects as one roentgen of x-ray or gamma ray radiation.

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Fernald's sampling equipment and data analysis were questionable and suggested that there be an independent assessment of Fernald's stack sampling procedures. Oak Ridge contracted with the Oak Ridge Associated Universities (ORAU)--a consortium of 52 universities--to conduct the assessment recommended.

In its August 1985 assessment report, ORAU identified significant problems in Fernald's exhaust stack monitoring systems, including corrosion of the sample probes and inadequate flow measurement systems. The ORAU report pointed out that Fernald's source sampling equipment did not provide accurate emission data and on-site monitors were poorly located. ORAU recommended that Fernald obtain meteorological data for wind patterns and use that data to locate its on- and off-site air monitors.

Fernald located two air monitors at local schools in July 1985 to help determine the impact of its operations on the surrounding community (DOE recommends five off-site monitors). Prior to that time Fernald had no off-site air sampling monitors. According to both a former Fernald environmentalist and a representative from the Southwestern Ohio Air Pollution Control Agency (an agency that monitors air pollution around Fernald and operates the school monitors), the two monitors might not provide accurate readings because both are placed at ground level subject to traffic or wind dust and one is downwind from a corn field. During field cultivation or fertilization, artificially high radionuclide readings would occur from the uranium occurring naturally in the soil and fertilizer. According to Fernald officials it does not plan to move these monitors.

Oak Ridge recognizes the shortcomings in Fernald's environmental monitoring systems. As part of the capital improvement program mentioned earlier, Fernald plans to replace 15 stack samplers beginning in December 1985 and complete upgrading a meteorological station in February 1986 to collect data needed to site other monitors. In the interim Fernald has used meteorological data from a local airport to locate two additional on-site and two additional off-site air monitors. These monitors should be operating by December 1985. Once on-site meteorological data are collected--about February 1987--Fernald will use them to ensure that these additional four monitors are placed in the optimum location. Fernald also plans to install high-efficiency particulate air filters as a backup for dust collectors. These filters reportedly will remove 99.97 percent of the dust remaining after emissions pass through the bag-type dust collectors. Fernald plans to install 56 filters between December 1985 and the early 1990's.

Contaminated soil

Fernald's cumulative air emissions over 30 years of operations have contaminated the soil both on- and off-site near

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the plant's boundary. For example, in 1984 Fernald found uranium concentrations as high as 65 parts per million in one area compared with the normal 1 to 5 parts per million of uranium in the soil around Fernald. According to Fernald's 1980 through 1983 annual reports, no hazards are associated with the uranium concentrations found. An official in Fernald's ES&H division told us Fernald plans to collect soil samples to determine if corrective actions are required.

No ALARA for environmental releases

Although Fernald must comply with DOE's environmental release standards, DOE also has a policy to keep radiation exposures to the environment, public, and workers as low as reasonably achievable (ALARA). In 1982 Fernald established ALARA goals for workers; it does not have goals for environmental releases or public exposures. On February 6, 1985, the Oak Ridge board that investigated Fernald's 1984 releases concluded that the plant did not have an effective ALARA program for environmental releases.

The wisdom of DOE's ALARA policy and its goal of preventing avoidable exposures has recently been demonstrated by changes that the International Commission on Radiological Protection and USEPA made relating to doses from radioactive air emissions. The commission concluded that some types of radiation cause larger organ doses than previously thought. DOE and USEPA officials told us that uranium emitted at Fernald could cause a lung dose 15 to 20 times greater than previously expected. In addition, USEPA in February 1985 reduced the maximum allowable dose to individuals from 0.5 rem to 0.025 rem for the whole body and from 1.5 rem to 0.075 rem for the critical organ.

Using USEPA's lower standards and the revised method for calculating critical organ doses, Fernald's historic emissions could have resulted in higher doses to the public than previously estimated. From 1952 through 1984 Fernald reported that it had never exceeded DOE's air standards. However, USEPA calculated the estimated doses and determined that, if its February 1985 standards were used, Fernald's releases could have exceeded USEPA's dose standard in almost every year. In 1956--Fernald's highest reported release year--it would have exceeded today's standard by 125 times. Fernald estimated that in 1984 it exceeded USEPA's new standard by 33 percent.

According to Fernald officials, one of the most significant assumptions made by USEPA was that the airborne particles discharged were smaller than what the plant is discharging today. If USEPA had used the larger particle size, then dose estimates would have been lower by a factor of 10. According to USEPA's Environmental Studies Branch Chief, if the particle

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sizes were larger, then the doses calculated would have been less. However, USEPA did not have historical particle size data but instead made certain assumptions when conducting its analysis.

Some radioactive water both on and off site

DOE Order 5480.1 establishes guidelines for radioactive liquid effluents discharged from its facilities. These guidelines are solely for effluents as they leave the plant site without regard to whether the treated water goes to a river, stream, or drinking water source. Once the treated effluents leave the site, neither DOE, USEPA, nor Ohio has policies or guidelines for uranium concentrations in water outside the plant boundary. Although the U.S. Public Health Service has standards for radioactive concentrations in municipal drinking water supplies, these standards are higher than DOE's for plant effluents. Therefore, DOE uses its concentration guides for plant effluents as a yardstick for assessing uranium concentrations in wells around Fernald. Although Fernald reports radioactivity within DOE's concentration guides, two on-site wells and three off-site wells--including one used for drinking water--show radioactive contamination.

Fernald routinely checks for uranium and plutonium concentrations in water in and around the plant by taking samples from

--the Great Miami River, the primary effluent point for Fernald's treated discharges, located about one mile east of the plant;

--Paddy's Run, a small stream near the west side of the plant, to determine the impact of surface water runoff;

--an on-site plant effluent line by means of a probe sampler; and

--on- and off-site wells.

Fernald treats its radioactive effluents to reduce the amount of radioactivity, combines them with sewage treatment water, and releases them primarily into the Great Miami River. Fernald has eight surface water monitors on and around the plant to measure the releases before going to the Great Miami River and Paddy's Run and for up to 4 miles up and downstream of the plant to ensure that releases are kept within DOE guidelines. On the basis of Fernald's 1980-1984 annual reports, the plant's releases have not exceeded DOE's guidelines.

Fernald began to routinely monitor radionuclides in on-site wells in 1976. Currently it has 13 on-site monitoring wells. In 1984 Fernald reported that it had two on-site wells

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contaminated with radioactivity--concentrations were as high as 90 percent of DOE's guidelines. A Fernald ES&H official told us that no plans exist to determine the source of the contamination but the wells will be monitored.

In 1981 Fernald expanded its well-monitoring program to include off-site wells. Fernald currently monitors 21 off-site wells and has identified 3--including 1 used for drinking water--that contain uranium contamination. The concentrations were within DOE's guidelines but sufficiently high to cause DOE and Fernald concern. A consultant hired by Fernald concluded that the uranium found in the three wells can probably be attributed to a sewer overflow problem.

In 1973 Oak Ridge identified particularly high uranium concentrations in the plant's sewer system but could not identify the source. Oak Ridge concluded that the sewer could not handle the surge of water after it rained and instead released water directly to the soil. Oak Ridge recommended that Fernald identify the source of uranium and take corrective actions. Although Oak Ridge continued to express concern in its appraisal reports for 4 more years, Fernald took no action until 1978 when it decided to construct a retention basin to catch the excess water. As a result of funding delays, however, the basin will not be completed until November 1985, compared to April 1984 as originally estimated.

Concerned about the off-site contamination, Fernald in April 1984 hired a consultant (Dames and Moore, White Plains, New York) to identify the source. The study pointed out that the source of the contaminated wells was probably the same source that caused the sewer system contamination identified by Oak Ridge in 1973. In its July 1985 report, the consultant identified two possible sources for the uranium found in the three off-site wells: water flowing into the storm sewer outfall ditch and water flowing into Paddy's Run from the waste pit storage area. The study recommended five short-term actions: construct a retention basin on site, regrade the area around the waste pits, drill a new drinking water well off site, excavate the uranium-bearing sediment in Paddy's Run, and expand the ground water monitoring system.

Fernald has taken some corrective actions. For example, Fernald expects to have the retention basin completed by November 1985. It drilled a new drinking-water well in February 1985. The new well is sampled monthly and has shown only background levels of uranium. As of October 1985, DOE was reviewing the other Dames and Moore recommendations before taking further actions. However, neither DOE nor Fernald has determined the long-term environmental or health consequences of the contamination. Fernald officials told us that they have calculated an estimated radiation exposure dose for individuals drinking the contaminated water and concluded that the doses were within DOE's standards.

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Because of citizen concern over the three contaminated off-site wells, DOE entered into a cooperative agreement with the Ohio Department of Health in 1985 to test local wells. That testing, which began in 1985, is provided free of charge at a citizen's request. As of August 30, 1985, 260 requests for testing had been made, and 212 wells had been sampled. Test results on 134 well samples showed no uranium concentration above background levels; test results for the remaining 78 samples had not been completed.

In 1985 to assuage public concerns about drinking water contamination, Ohio EPA also hired a consultant (Geo Trans, Inc.) to conduct a regional ground water study of the Dayton and Fernald area to identify pathways for water contamination. The consultant did not sample water sources but relied on DOE, the U.S. Geological Survey, Dames and Moore, and the Ohio EPA data. The study, published on September 30, 1985, concluded that Fernald's on-site waste disposal pits could contaminate an on- and off-site aquifer but more data are needed. The report made six recommendations including that Fernald collect samples from all available wells (both on- and off-site), establish a baseline monitoring program to fully define the extent and type of contamination, and drill 36 additional on-site monitoring wells. DOE and Fernald received the report on November 4, 1985, and are reviewing its findings and recommendations before deciding on actions needed.

Impact of Fernald's air and water releases on the community

The release of radioactive material to the air and water can lead to increased public exposures. In addition to air and water release standards, DOE establishes an exposure limit for a hypothetical individual living around a plant who gets the greatest possible exposure from all sources--air, water, and food. DOE's standard is 0.5 rem for the whole body and 1.5 rem for the lung. For the last 5 years Fernald's reported exposures for the maximally exposed individual have been within DOE's guidelines. These are shown in table I.1.

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Table I.1: Comparison of Whole-body and Critical Organ Doses to DOE's Standard for the Maximally Exposed Individual:[a] 1980-1984

	Whole body		Lung[b]	
Year	Dose (rem/year)[c]	Percent of standard	Dose (rem/year)[d]	Percent of standard
1980	0.010	2.0	0.0036	.24
1981	.009	1.8	.008	.53
1982	.012	2.4	.012	.80
1983	.010	2.0	.032	2.13
1984	.066	13.2	.100	6.67

[a]The maximally exposed individual is the hypothetical individual who remains at the plant boundary and who, when all potential sources of exposure from a facility's operation are applied, would receive the greatest dose.

[b]The most critical organ will vary depending on the type of radiation released from the facility.

[c]The exposure due to natural background radiation in southwestern Ohio is about 0.115 rem. This is not included in the dose data.

[d]For the years 1980-1982, lung doses were calculated using the old International Commission on Radiological Protection methodology. For the years 1983-1984, the revised method for calculating lung doses was used.

As a result of public concern about the effect of Fernald's operations on the public, DOE invited the people living around the plant to be checked for radiation exposure by the Oak Ridge mobile radiation monitor. Ninety-eight people participated and were tested for uranium and radon exposure. Of these, 86 tested at levels similar to people who had no known exposure to uranium. Of theremaining 12 people, 3 (2 were former Fernald employees) had readings in the upper portion of the normal range for uranium,and 9 had detectable levels of radon exposures. Radon occurs naturally in the environment and in home building materials: a well-insulated house can trap radon gas inside the dwelling. In June 1985, as part of an agreement with DOE, the Ohio Department of Health began monitoring the homes of the nine people showing radon exposure. A department official told us that the homes must be monitored for a year before any conclusion can be reached about the source of the radon.

Release of nonradioactive material

According to its reports, Fernald primarily releases nonradioactive material to the air from its steam generation boiler plant. These materials include sulphur dioxide and suspended particulates. In addition, Fernald discharges water

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contaminated with chemicals to the Great Miami River under a permit issued by USEPA and administered by Ohio EPA. The permit was issued under the National Pollutant Discharge Elimination System (NPDES) program. Fernald is required to characterize its discharge water by analyzing samples and reporting the results to USEPA quarterly and to Ohio EPA monthly. Among other things, Fernald monitors acidity, ammonia, oil and grease, and solid material suspended in the water.

Air releases

The Southwestern Ohio Air Pollution Control Agency monitors nonradioactive particulate matter (flyash, dust, and smoke) and liquid particles (spray and mist) for the area around Fernald with a single, stationary monitor. The objective is to monitor all air releases in the area rather than those specifically from Fernald. The agency also keeps track of boiler plant emissions by reviewing Fernald's reports. According to the agency's area supervisor for industrial programs, all Fernald's emissions have been in compliance except in the late 1970's when two of the plant's four boilers exceeded the Clean Air Act requirements. The two boilers were shut down because they were no longer needed.

Water releases

Fernald's most recent NPDES permit was issued in 1980 (permits are renewed every 5 years) by USEPA. However, the permit was contingent upon DOE taking certain actions to improve Fernald's discharge and pollution controls. DOE agreed to construct four new facilities by April 1984--a sewage disinfection facility, water retention basin, water runoff control trough, and a nitrate removal system. However, DOE did not meet the April 1984 schedule. The sewage disinfection facility was not completed until August 1984; the runoff trough was completed in September 1985; the retention basin is scheduled to be completed in November 1985; and the system to remove nitrates is scheduled to be completed in December 1986.

Ohio EPA conducted NPDES inspections at Fernald in 1984 and 1985 and reviewed its water-sampling reports. Fernald's 1984 report showed that 31 of 1,820 samples (1.7 percent) exceeded permit limits. Nevertheless, Ohio EPA found the plant in compliance with its permit. However, on December 18, 1984, the Ohio attorney general notified DOE and Fernald of the state's intent to file suit for water pollution violations. The alleged violations cited (1) specific dates when discharges exceeded permit limits and (2) failure to adhere to the agreed-upon construction schedule for pollution control improvements. As of November 1, 1985, DOE and Ohio EPA were negotiating an out-of-court settlement.

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In addition, Fernald in 1984 identified two on-site test wells that had elevated levels of various materials (these two wells were also contaminated with radioactivity and were discussed earlier). One well had chemical concentrations ranging from 298 to 795 percent above Ohio EPA's maximum drinking water standard; the second had concentrations 224 percent above the standard. While Fernald uses these wells only to test for possible ground water contamination and not for drinking water, the high level of contamination was not anticipated. Fernald plans to determine the extent and cause of the contamination before deciding whether corrective action is needed.

Waste disposal at Fernald

A large quantity of low-level radioactive and mixed (combination of both radioactive and hazardous) waste is generated and stored at Fernald. No solely hazardous waste is generated or stored at the site.

Radioactive waste

Fernald has used two types of facilities for the long-term storage of low-level radioactive waste: six in-ground pits and three above-ground concrete silos. Fernald estimates that about 500,000 metric tons of uranium and other waste such as lime and nitrates contaminated with uranium had been disposed of in these facilities. Since 1983 only one pit has been used to store contaminated construction rubble and graphite crucibles. All other waste is placed in steel drums and either stored on site or shipped to a DOE waste disposal facility in Nevada.

In an attempt to reduce the amount of low-level waste disposed, Fernald in fiscal year 1986 will begin construction of a low-level waste processing and shipping facility. This facility will process newly generated low-level radioactive waste streams into a form suitable for shipment and disposal at DOE's Nevada storage site. Construction is scheduled to be completed in fiscal year 1988. In addition, on July 25, 1985, Fernald issued a request for proposal for a study to identify options for better ensuring the environmental integrity of its low-level waste storage facilities. The study would identify the contents of the pits and silos, actual or potential environmental impacts, and alternative disposal methods. The study is expected to be completed by March 1988.

Mixed waste

Only small quantities of mixed waste are generated at Fernald. Most of the mixed waste stored there has come from DOE facilities located in Tennessee and Ohio. Fernald generates about 1,100 pounds of mixed waste a year but has received almost 174,000 pounds from the other facilities. Fernald expects to process some of the mixed waste--about 17,000 pounds--thereby converting it to a nonhazardous material. Other mixed waste

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will eventually be shipped to Oak Ridge for incineration. Oak Ridge expects to begin constructing the incinerator in 1986 and complete it in 1987.

On March 16, 1984, Ohio EPA inspected Fernald to determine compliance with hazardous waste laws. Although Fernald does not generate material classified as hazardous waste only, the state believes that mixed waste is subject to its hazardous waste laws. Ohio EPA found numerous violations with Fernald's mixed waste storage, monitoring, and documentation procedures. According to Ohio EPA officials, Fernald has been out of compliance with hazardous waste laws since March 16, 1984.

IMPROVEMENTS TO WORKER HEALTH AND SAFETY PROGRAMS

At Fernald workers must be protected against radioactive, hazardous, and occupational safety hazards. Fernald's worker health and safety programs are administered by Oak Ridge's Environmental, Health, and Safety Division. Although Fernald has reported only one worker as exceeding DOE's radiation exposure levels since the plant opened in 1952, a DOE study conducted in March 1985 (discussed later) found several deficiencies in Fernald's radiation protection program.

Health physics program

The primary radiological (health physics) worker concerns at Fernald are inhalation of dust and external exposure to beta radiation. The principal methods Fernald uses to protect workers from inhaling contaminated dust are ventilation systems to collect the dust and personal respirators. To protect against beta radiation exposure, Fernald provides metal shielding for some work areas. Fernald has also instituted administrative controls (such as rotation of employees on high-exposure jobs) to minimize individual exposures from contaminated dust and beta radiation. DOE Order 5480.1A establishes worker radiation protection standards. The standard for a whole-body exposure is 5 rem a year; the maximum for a skin or lung exposure is 15 rem a year, or 5 rem a quarter. DOE's exposure standards for workers are less stringent than those applicable to the general public. The order also states that exposures should be kept within ALARA objectives.

Fernald uses four methods to measure worker exposures. Since 1983 Fernald has used thermoluminescent dosimeters (TLD) to measure external radiation; the TLDs are read monthly. Prior to 1983 film badges were used. Second, a mobile radiation monitoring laboratory (commonly called a body counter) visits Fernald about twice a year. The counter estimates the amount of uranium collected in the employees' lungs. Not all employees are counted--only those working in potentially hazardous areas are monitored. In addition, urine samples are collected and analyzed on a weekly or monthly basis to ensure that significant

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intakes of radioactive material have not occurred. Finally, portable air samplers periodically measure the level of airborne uranium throughout the plant.

In 1952 Fernald reported that two workers had received whole-body exposures of 5.1 rem; at that time the standard was 15 rem. Since then, no worker has exceeded DOE's current 5-rem, whole-body standard. However, between 1963 and 1965 about 109 of 6,025 employees tested were reported to have received whole-body exposures in the 2- to 4-rem range. For the past 5 years, however, no employee has reportedly received a 2-or-more rem exposure. Table I.2 shows the reported annual exposure results for the last 5 years, primarily based on film badge readings.

Table I.2: Reported Employee Whole-body Radiation Exposures at Fernald: 1980-1984

Year	Total employees reported	No exposure	Up to 1 rem	1 to 2 rem
1980	642	118	516	8
1981	701	156	538	7
1982[a]	262	0	247	15
1983	310	5	304	1
1984	419	14	405	0
Total	2,334	293	2,010	30

[a]In 1982 the total employees reported decreased because those who do not work with radioactive materials (clerical and administrative personnel) were not included.

No employee was reported as receiving an internal body exposure that exceeds the 15-rem standard for lung exposure. During the period 1969 through 1975, the number of employees who received greater than half the standard (7.5 rem) varied from 10 to 23 a year. For the past 5 years, the number of individuals varied from 1 to 6 a year. After uranium releases were made public in December 1984, 97 employees were tested using the body counter. All exposure levels were within DOE's standard.

In 1980 one employee received a beta radiation dose to the skin of 8.7 rem, which exceeded DOE's quarterly limit of 5 rem. The employee was reassigned to a less hazardous job, and subsequent monitoring showed reduced dose levels. However, Oak Ridge noted that starting in 1983 the number of employees receiving beta radiation doses was increasing. In an effort to reverse this trend, Fernald has instituted a pilot project to change its processing operations that could, according to its officials, significantly reduce future beta radiation exposures.

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Compliance with ALARA goals

In 1982 Fernald implemented an ALARA program for workers. The ALARA goals Fernald established related to improved reporting of worker exposures, notification of supervisors when personnel monitoring showed increased doses, radiation avoidance training programs, and a study of the plant to determine possible dose rates for certain types of jobs. According to Oak Ridge, Fernald met its 1982 and 1983 goals. Oak Ridge did not determine whether Fernald met its 1984 goals, nor has Fernald established 1985 goals. According to Fernald's health physicist, the increase in workload following the 1984 releases precluded these activities. Although Oak Ridge believes that Fernald has taken a step in the right direction by establishing ALARA goals for workers, a 1985 report recommended that quantifiable worker exposure limits should be established.

Assessment of health impacts

Several studies of the long-term consequences of Fernald's activities and the impact of its 1984 uranium releases have either been completed or are still ongoing. A synopsis of the studies dealing with the long-term consequences follows.

--Oak Ridge Associated Universities (ORAU) completed a a morbidity (illness) study for Fernald in 1983. Fernald was one of 76 facilities included in the DOE-wide study. The study concluded that an "apparent association" exists between exposure levels and nonmalignant respiratory diseases at Fernald. At the request of a local congressman, the U.S. Department of Health and Human Services reviewed the study results and concluded that the evidence presented did not justify the conclusions reached. Health and Human Services concluded that the ORAU study did not consider age, smoking habits, time period, socioeconomic status, and exposure to other chemicals as contributing factors for the apparent association found. As a result of these comments, ORAU conducted further analysis and in December 1984 concluded that its initial findings were not supported and that present or past occupational conditions at Fernald do not constitute an unacceptable hazard to workers. ORAU plans to do additional analyses taking into account the factors identified by the Department of Health and Human Services.

--In 1976 ORAU began a mortality (death) study of all DOE facilities including Fernald. At Fernald ORAU reviewed the circumstances surrounding the deaths of 400 Fernald workers between 1952 and 1977. A preliminary draft showed that Fernald's employee death rate is lower than for the national population. ORAU is in the process of compiling another 5 years of data--1978 through 1982--and expects to report its results by the end of 1986.

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--In 1985 a DOE task force undertook a study of the safety and health effects of workers handling and processing plutonium-contaminated material. In 1980 Fernald received material containing plutonium in significantly higher than the normal 3-to-35-parts-per-billion concentrations--up to 7,757 parts per billion. In 1985 DOE defense program officials found that Fernald did not have documents showing the concentration of material moving through its production process. As a result, DOE could not determine the level of radiation to which Fernald's employees had been exposed. According to the report, Fernald was among several DOE facilities to experience this problem. The report, completed in September 1985, found that Fernald could have kept better documentation concerning the disposition of this material and that Fernald needed to give greater attention to worker safety and radiation exposure controls. However, the study did not identify any instance where Fernald's workers or the public was jeopardized.

--At the request of Fernald's employee union, the National Institute of Occupational Safety and Health (NIOSH) in 1985 began a review of urine test results and other exposure records for Fernald's employees. After reviewing these records, NIOSH conducted a more detailed evaluation in September 1985 in which 134 employees with 10 or more years of work experience at Fernald participated. For these employees, NIOSH took blood and urine samples to assess uranium exposure and pulmonary tests and chest x-rays to determine the effect of these exposures on the lungs. A NIOSH official told us that the results of its evaluation will be available in January 1986.

Following is a synopsis of the studies directly related to the impacts of Fernald's 1984 releases.

--During March 6-8, 1985, a DOE team--at the direction of the Assistant Secretary for Defense Programs--evaluated Fernald's health physics program.[2] The team's report concluded that the program has many shortcomings and recommended numerous corrective actions. The deficiencies found were that (1) Fernald did not have sufficient staff to maintain operations and make needed

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[2]Employees from six DOE facilities, such as Los Alamos and Lawrence Livermore, and a health physics specialist from headquarters who confined his review to plant recordkeeping made up the team.

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improvements, (2) the in-vivo (lung) radiation counter should visit Fernald more than twice a year as scheduled, and (3) the plant had large amounts of radioactive contamination. Recommendations were made to improve the operational, administrative, and medical aspects of Fernald's health physics program and environmental controls in the workplace. For example, the report recommended that the plant should be thoroughly cleaned to bring it into line with stringent ALARA goals, employees should be monitored before they leave the site to ensure they do not take uranium dust out of the plant on their clothes or shoes, and quantifiable ALARA worker exposure limits should be established. Despite these shortcomings, the team concluded there was no evidence that employees' health was in jeopardy.

--At the request of Fernald's employee union, an industrial hygienist with the International Chemical Workers Union and a radiological health consultant from the Massachusetts Institute of Technology assessed the adequacy of Fernald's worker health and safety program in August 1985. In a preliminary report to the local union, the industrial hygienist made 11 recommendations to improve working conditions and communications between workers and Fernald management. Specific recommendations include more reliance on engineering controls to eliminate exposure sources, better maintenance of ventilation systems, and more attention to nonradiation hazards such as exposures to acid mist and nitrogen oxides that reportedly caused frequent irritations to workers. The preliminary report also noted that Fernald should improve the quality, timeliness, and frequency of exposure data provided its workers.

Improvements to radiation programs

Fernald has acted to implement some of the recommendations contained in the March 1985 health physics study. For example, personnel are cleaning contaminated work surfaces, and hand and foot monitors were purchased to check employees before they leave their work areas. Further, DOE is planning to request fiscal year 1987 funding to build barriers to separate contaminated and noncontaminated areas.

Industrial hygiene

Inhalation of chemical fumes, some of which are toxic, is the principal industrial hygiene (hazardous material) concern at Fernald, according to its officials. The principal method Fernald uses to protect the workers is ventilation systems. Respirators are used for certain operations. Fernald also provides new employees with training on the use of respirators

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and tests the employees to determine the type of respirator that provides the best protection.

Fernald uses chemical exposure standards mandated by DOE Orders 5480.4 and 5480.10 to assess worker exposure to hazardous substances. DOE's orders reference standards published by the American Conference of Government Industrial Hygienists (ACGIH) that cover about 500 chemicals and are updated yearly. An industrial hygienist at Fernald stated that these standards are more restrictive and more current than the Occupational Safety and Health Administration (OSHA) standards issued in 1972. Air sampling, the primary measure of compliance with these standards, involves taking work area samples with a portable monitor and providing employees an instrument to sample the contaminants they breathe. A 1982 Oak Ridge appraisal report reviewed air samples Fernald collected between September 1981 and June 1982. The report concluded that only one chemical--in the plant laundry--was found in concentrations that exceeded the ACGIH standards. As a result, Fernald requires laundry workers to wear respirators, and an industrial hygienist conducts inspections to determine whether these procedures are followed.

Oak Ridge appraisals conducted in 1981 and 1982 rated Fernald's industrial hygiene program as satisfactory. Nevertheless, problems were noted such as the need for Fernald to take more chemical samples and to improve its recordkeeping practices. The 1983 appraisal noted that Fernald had made excellent progress to correct the deficiencies previously noted but that Fernald needed to computerize the results of its air sampling program for all employees to enhance its personnel monitoring program. Fernald has complied with this recommendation and plans to purchase permanent air sampling equipment and institute a training program to notify workers of the hazards to which they are exposed. These additional actions are expected to be completed by January 1986.

Occupational safety

Fernald's health and safety staff annually survey all areas of the plant to ensure compliance with DOE orders, OSHA regulations, and American National Standards Institute standards. The health and safety staff also perform other functions such as reviewing purchase orders for safety-related equipment, investigating injury reports, overseeing a safety award program, and holding monthly meetings with union representatives and management. Fernald also has a fire department and a medical department.

DOE uses two indicators to evaluate worker safety at its plants: lost workday cases and rate of lost workdays. DOE compares individual plants against DOE-wide rates and rates for the chemical and allied products industry. The comparison for Fernald is shown in table I.3.

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Table I.3: Comparison of Fernald's Reported Accident Statistics With DOE and Industry Rates: 1980-1984

	Lost workday case rate			Lost workdays rate		
Year	Fernald	DOE-wide	Chemical and allied products industry	Fernald	DOE-wide	Chemical and allied products industry
1980	.79	1.1	1.14	25.0	18.1	23.0
1981	.90	1.0	1.32	46.0	14.9	26.0
1982	1.20	1.0	1.06	22.0	13.5	21.0
1983	1.10	1.1	.95	33.0	20.3	20.0
1984	.70	1.1	.91	26.4	16.7	17.0

Oak Ridge appraisals conducted in 1981, 1982, and 1983 rated Fernald's occupational safety program as excellent. However, the appraisals noted an upward trend in injuries. Fernald officials attributed the increases to the large influx of new, inexperienced employees. In 1984 injuries decreased, and Fernald officials believe that injury rates will continue to decrease. During the last 5 years, there has been one fatality at Fernald. The death is not included in the data in the table above but was reported separately to DOE. DOE's investigation report concluded that the death was not related to safety deficiencies.

Fernald officials also stated that the National Safety Council has placed Fernald in the nonferrous metals industry category rather than the chemical and allied products category and Fernald's injury rates are well below that industry's rates. However, DOE continues to evaluate the number and severity of Fernald's injuries on the basis of the chemical and allied products industry rate.

Union representatives want independent reviews

Union officials at Fernald told us that they believe that (1) health and safety reviews should be performed by someone other than DOE, (2) atomic energy workers should come under OSHA's jurisdiction, and (3) a government agency--other than DOE--should conduct research on the health effects of radiation on workers. They said these changes are needed to eliminate the potential conflict caused by DOE checking on itself.

AWARD FEE SYSTEM FOR FERNALD

Fernald operates under a cost-plus-award-fee contract. Every 6 months officials at Oak Ridge evaluate Fernald's performance and award a fee, if warranted. Prior to each

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contract period, Oak Ridge and Fernald officials agree to broad categorical goals that will be included in the award fee evaluation. For example, the management and administration category includes ES&H activities. However, the weight ES&H activities carry in the award fee process are not discussed. Oak Ridge sets the weights at the end of the award fee process.

With the exception of the 6-month period ending March 1985 when Fernald received no fee, between April 1980 and September 1984 Fernald had always received between 76 and 85 percent of the available fee. In support of the decision to award no fee, Oak Ridge's manager stated that it was primarily the result of both Fernald's failure to maintain a minimally acceptable level of environmental management performance and a less-than-standard safety, maintenance, and engineering performance.

The following illustrates the mechanics of Oak Ridge's award fee process for the second half of fiscal year 1984 for Fernald. The first step involved assigning Oak Ridge technical and administrative officials, with the proper mix of expertise, to performance evaluation committees. The committees monitored, reviewed, and evaluated Fernald's performance in five functional categories: production operations, safety and environmental control, maintenance management, budget, and engineering and construction. The committees then assigned numerical ratings to each category and submitted their reports to an award fee board composed of Oak Ridge's assistant managers for defense programs, safety and environment, and administration and directors of its office of performance evaluation and weapons division.

The award fee board reviewed the ratings and assigned weights to each functional category. It then computed the weighted rating for each category and the total weighted ratings for each major performance area (management and administration, resource management, and production). Table I.4 illustrates the computations made for the management and administration area at Fernald.

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Table I.4: Computation Made for the Management and Administration Area at Fernald

Functional category	Rating	Weight	Adjusted rating (rating x weight)
Production operations	94	50	47.00
Safety and environmental control	85	15	12.75
Maintenance management	90	10	9.00
Budget	85	15	12.75
Engineering and construction	82	10	8.20
Total		100	89.70

Using the established weights for the major performance areas, the board then computed the overall rating. Table I.5 illustrates this computation.

Table I.5: Major Performance Area Rating

Major performance area	Rating	Weight	Adjusted rating (rating x weight)
Management and administration	89.70	30	26.91
Resource management	89.05	30	26.72
Production	91.85	40	36.74
Composite overall rating		100	90.37

Fernald earns no fee for ratings of 60 or less. For each point above 60, Fernald earns 2.5 percent of the available award fee. In this case, the numerical rating of 90.37 translates to 75.9 percent of the total fee available. Fernald received $680,826, which was the amount the award fee board recommended to Oak Ridge's manager. The manager reviewed the board's recommendation and, on the basis of professional judgment and knowledge of Fernald's performance, determined the amount of the award fee. In this case, the manager agreed with the board's recommendation.

Because of the uranium releases between September and December 1984, Oak Ridge's manager determined that environmental matters should be given greater emphasis in the award fee process. Beginning with the April 1985 appraisal, the functional category of safety and environment was eliminated and two categories were added: (1) safety, health, and fire protection and (2) environmental management and protection. Besides this change, the manager and deputy manager plan to meet with the award fee board members and the chairman of the performance evaluation committee to ensure that proper

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considerations and weights have been given to each evaluation criterion.

INDEPENDENT VERIFICATION OF FERNALD'S AIR EMISSION DATA

In two previous reports,[3] we noted that DOE had not taken advantage of available independent information--state or local--to test the accuracy of contractor data. No federal, state, or local agency has ever monitored radionuclide air emissions from Fernald or verified its data. Officials from both Ohio EPA and the Southwestern Ohio Air Pollution Control Agency told us that their monitoring authority does not include radionuclides. Because of public concern, Fernald recently contracted with the Southwestern Ohio Air Pollution Control Agency to monitor the two off-site air samplers that Fernald placed at local schools in July 1985. However, the state has some concern about the accuracy of the readings provided by these monitors because the air samplers are located too close to the ground and may provide distorted readings from nearby traffic and farming operations.

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[3]Better Oversight Needed for Safety and Health Activities at DOE's Nuclear Facilities (EMD-81-108, July 27, 1981) and DOE's Safety and Health Oversight Program at Nuclear Facilities Could Be Strengthened (RCED-84-50, Nov. 30, 1983).

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PROGRAMS TO PROTECT THE ENVIRONMENT AND WORKER HEALTH AND SAFETY AT PORTSMOUTH

The Portsmouth Uranium Enrichment Complex, which began production in 1955, is located in Pike County in southeastern Ohio. The complex is operated by the Goodyear Atomic Corporation, a wholly owned subsidiary of The Goodyear Tire & Rubber Company. As of October 1985, the plant employed about 2,100 people. Portsmouth's mission is to convert solid uranium hexafluoride to a gas and increase or enrich one isotope of the gas to between 2 and 5 percent for commercial reactors and to more than 93 percent for nuclear weapons programs. The plant is among the largest industrial facilities in the world--covering more than 10 million square feet of building space on 3,800 acres.

DOE's Oak Ridge Operations Office is responsible for providing Portsmouth with technical assistance and for monitoring its compliance with environmental and worker protection standards. Oak Ridge carries out its oversight responsibilities primarily through periodic appraisals designed to test the adequacy of Portsmouth's system to accomplish DOE's ES&H objectives and inspections to ensure compliance with health and safety standards, regulations, and procedures. It has been over 2 years since Oak Ridge conducted an industrial hygiene (nonradioactive) inspection at Portsmouth. According to DOE officials, while in some cases formal on-site audits have not been conducted, site visits, inspections, and communications have provided DOE information on Portsmouth's ES&H program.

DOE states that it encourages high-quality performance by setting goals and objectives in Portsmouth's cost-plus-award-fee contract. When Portsmouth meets these goals, DOE pays a fee. DOE determines the amount of the fee through periodic performance evaluations using preestablished criteria. One area considered in the award fee process is ES&H.

ENVIRONMENTAL PROTECTION: STATUS AND ISSUES

Portsmouth uses and produces a variety of radioactive and nonradioactive (hazardous) substances that could contaminate the environment--air, water, and soil--if not properly controlled. Portsmouth annually reports its environmental monitoring results to DOE, USEPA, Ohio EPA, and the public. Although Portsmouth has released radioactivity to the environment, its reports indicate that all such releases have been below DOE's standards.

However, Portsmouth has not identified all sources of hazardous emissions nor obtained permits from Ohio EPA for all hazardous substances released as required. DOE officials pointed out that most of these sources are not of major

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significance for air emissions, for example ventilation vents and diesel generator exhaust stacks, and the permits that have not been approved primarily relate to a facility that has been cancelled. Portsmouth's environmental monitoring reports show that the plant releases one hazardous substance--fluoride--in quantities above the standard imposed by other states. At this time no federal agency nor Ohio has a fluoride standard.

Air emissions

To ensure that radioactive air emissions are kept at a minimum, DOE requires Portsmouth to monitor and document its releases. Portsmouth, using meteorological data, placed 4 on-site and 5 off-site air monitors. DOE recommends 5 off-site monitors. It also has 26 soil sample locations around the plant. Portsmouth reports that its air emissions have been below DOE's standards for the last 5 years. However, in 1985 Portsmouth conducted a study to identify all its air emission points and evaluate the emissions from each. It found that not all points were continuously sampled, particularly in its process and decontamination buildings and high-assay sampling area. Portsmouth is in the process of installing 4 additional permanent air monitors and determining whether 13 other release points require additional monitors.

Portsmouth also removes and discharges gases from the enrichment process. The vented gas passes through traps that reduce the uranium concentration before venting to the atmosphere. Portsmouth's records show that air emissions have been within DOE's standards and that the highest average radioactive concentration in the material released during the last 5 years was 0.12 percent of the DOE standard. An Oak Ridge study of uranium losses found that Portsmouth had been releasing uranium gas in quantities greater than had been reported. Subsequently, Portsmouth installed new equipment to reduce and measure the gas released.

Water releases

According to its reports, most of Portsmouth's radioactive releases occur through liquid effluents. In 1984 Portsmouth had 18 water sampling locations--9 on site and 9 off site as much as 5 miles from the plant. Seven of the off-site water samplers are located on three creeks near the plant. Portsmouth also monitors stream sediment at 10 off-site locations up and downstream of the plant. According to its data, Portsmouth's releases since 1980 have been within DOE's guidelines--the highest measured radioactive concentration was 6.2 percent of DOE's guide.

Although releases have been within DOE's guide, Portsmouth found a buildup of uranium particles in a creek that receives most of the plant's treated water. The uranium contamination is within DOE's guidelines. This creek flows into the Scioto River

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located about 1 mile west of the plant. Portsmouth takes and analyzes water samples from the river to ensure there is no increase in radioactive or chemical properties resulting from plant operations. The average concentration for uranium particles in the creek sediment sampled at the plant boundary during 1984 was 16 micrograms of uranium per gram--compared to 3.6 micrograms for samples taken upstream of the plant. According to the environmental control program supervisor, Portsmouth found the contamination in 1975, and the uranium concentration has been the same since that time. Information in Portsmouth's environmental monitoring reports shows no increase of uranium in the Scioto River as a result of the contaminated creek sediment.

Dose assessment of off-site population

The release of radioactive material to the air and water can lead to exposures of local residents. Portsmouth calculates the potential radiation dose to residents on the basis of its emission data. The following table shows the calculated exposure for individuals living at the plant boundary for the last 5 years and the relationship between that exposure and USEPA's standards (see footnote to table II.1). Natural background radiation of about 0.125 rem is excluded from the dose information in table II.1.

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Table II.1: Comparison of Whole-body and Critical Organ Dose to USEPA Standard[a] for the Maximally Exposed Individual: 1980-1984

Year	Whole body		Bone[b]	
	Dose (rem/year)	Percent of standard	Dose (rem/year)[c]	Percent of standard
1980	0.00068	2.7	0.00613	24.5
1981	.00026	1.0	.00180	7.2
1982	.00015	0.6	.00096	3.8
1983	.00083	3.3	.00950	38.0
1984	.00044	1.8	.00052	2.0

[a]The DOE standard is 0.5 rem for the whole body and 1.5 rem to critical organs. Oak Ridge voluntarily applies a more stringent USEPA standard to Portsmouth's operations. The USEPA standard, which went into effect December 1, 1979, is 0.025 rem for the whole body and all critical organs except the thyroid, which is 0.075 rem.

[b]The most critical organ will vary depending on the type of radiation released from the facility.

[c]From 1980-1982 bone doses were calculated using the old International Commission on Radiological Protection methodology. For 1983 and 1984, the revised calculation method was used.

Nonradioactive releases

The Clean Air Act of 1970 and the Clean Water Act of 1972 regulate nonradiological discharges to the environment. The Ohio EPA issues permits for allowable levels of hazardous air emissions and regulates water effluents through the NPDES permits. Ohio EPA has issued only 5 of 19 operating permits requested by Portsmouth under the Clean Air Act. However, Portsmouth has not identified or documented all hazardous air emissions to ensure they are included in the 19 permits requested. Although Ohio EPA has issued Portsmouth two NPDES permits, its liquid effluent releases have not always met permit requirements.

Airborne emissions

According to its own reports and a consultant's study, Portsmouth has not demonstrated to Ohio EPA that all sources of hazardous air emissions are included in air emission permits or applications, nor have permits been issued covering all known releases. Ohio EPA has not issued Portsmouth's permits for all known hazardous discharges because, according to officials, of a heavy work load. Portsmouth is now attempting to identify all sources of air emissions on a building-by-building basis to

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determine whether additional air pollution permits may be required.

A consultant found that Portsmouth is out of compliance with Ohio regulations because (1) it does not have documentation to support that it has applied for all air emission permits and (2) in cases where Portsmouth has applied for permits, it does not have documentation from the state granting interim operating authority until the permits are issued. DOE pointed out that most of these sources are not of major significance as air emission points, for example, ventilation fans and diesel generator exhaust stacks, and the permits that have not been received primarily apply to the operation of a facility that has been cancelled.

In addition, Portsmouth releases a toxic substance--fluoride--into the air. Although fluoride emissions are not regulated by Ohio or USEPA, Portsmouth monitors these emissions and includes the results in its annual environmental monitoring reports. The data show that Portsmouth's emissions would not meet state standards in Kentucky or Tennessee, where the only other DOE uranium enrichment plants are located. For example, Tennessee's standard is 1.2 micrograms per cubic meter averaged over 30 days. Portsmouth's highest yearly average concentrations of fluoride were 2.19 and 1.58 micrograms during 1983 and 1984, respectively, but Portsmouth has had monthly concentrations as high as 15.1 micrograms. According to the supervisor of environmental control, Portsmouth is attempting to identify and develop ways to reduce the fluoride emissions in the event the federal or state government adopt regulations limiting the quantities released.

Water releases

Portsmouth releases a variety of hazardous liquid effluents. The Ohio EPA established standards for each of 18 release points identified in the two NPDES permits issued to Portsmouth. Daily average and daily maximum limits for each pollutant must not be exceeded. Pollutants include mud, oil and grease, residual chlorine, nitrates, ammonia, copper, zinc, iron, nickel, chromium, manganese, arsenic, and sewage treatment plant effluents.

During calendar year 1984, Portsmouth achieved an average compliance rate of 94.7 percent for hazardous liquid effluents. It had 261 violations--187 for exceeding the daily maximum discharge limits and 74 for exceeding the daily average discharge limits. The greatest percentages of noncompliance occurred at three discharge points: a nitrate conversion plant, a coal pile treatment plant, and a holding pond. The nitrate plant exceeded zinc and nitrate limits. However, the Ohio EPA recognizes that Portsmouth's processing technology is the best available and plans to relax the nitrate and zinc limits. Ohio EPA also plans to relax permit limits for the coal pile

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treatment plant to make them consistent with other, similar treatment facilities in the state. Further, Portsmouth plans to identify the amount and type of waste entering the holding pond and then treat the waste to bring the pond into compliance with state standards.

Waste Management

Portsmouth generates and stores a variety of radioactive and hazardous substances. Some radioactive waste with low levels of contamination is buried there. Portsmouth also treats some liquid waste in a holding pond. Portsmouth has detected uranium and hazardous substances in on-site wells near the burial site and the holding pond. These problems are discussed later. In addition, since about 1963 Portsmouth has stored about 80,000 cubic yards of a toxic substance--lithium hydroxide--that came from Oak Ridge. Some of the containers, according to Portsmouth officials, have deteriorated, and the material may have to be transferred to new containers.

In May 1985 USEPA sent DOE a notice of noncompliance with the Toxic Substances Control Act because of Portsmouth's polychlorinated biphenyl (PCB) contamination problems.[1] The problems noted were that the plant's cascade (portion of the plant that enriches uranium) lubrication system, about 24,000 cubic feet of soil in a drainage ditch, and 800 drums of sludge at an old sewage treatment plant are contaminated with PCBs. In addition, the exhaust ventilation system in the cascade building drips PCBs onto the floor.

For Portsmouth to fully comply with USEPA's toxic substance regulations, it would have to

--drain and replace about 150,000 gallons of the cascade lubrication oil that is contaminated with PCBs. Oak Ridge does not plan to replace the oil because it would cost about $3.5 million including the cost to shut down and restart the enrichment cascade. Portsmouth states it will inspect the cascade for drips and spills and clean them to minimize contamination.

--replace about 13,000 gaskets in the cascade building ventilation system to eliminate PCB contamination. Portsmouth does not plan to do this because it could cost as much as $5 million. However, Portsmouth has developed a method to catch the drips and prevent contamination of the process building floor. Since 1983 about 1,000 to 1,500 drip catching devices have been installed.

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[1]Laboratory tests on animals show that PCBs can retard human reproduction and growth, cause skin lesions and tumors, and injure the liver.

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Portsmouth will periodically inspect the cascade building and add drip catchers as new drips occur.

--dig up an estimated 24,000 cubic feet of contaminated soil, package it in drums, and ship it to a hazardous waste disposal site. Portsmouth will initiate a sampling program to determine the extent of the contamination. Once the sampling is completed, Portsmouth plans to excavate the soil when project funding becomes available.

--incinerate the sewage treatment sludge. Since all 800 drums of sludge contain some uranium and no permanent storage facility exists for mixed waste material, Portsmouth will temporarily store these drums until some time in fiscal year 1987 when an incinerator becomes operational at Oak Ridge. At that time, Portsmouth expects to send the 800 drums to Oak Ridge for processing.

On July 2 and July 11, 1985, Oak Ridge sent letters to USEPA setting out the above actions. According to a USEPA official, it considers Portsmouth to be in compliance with federal toxic substance regulations if the actions described above are taken. This is so even though Portsmouth does not plan to replace the contaminated cascade lubricating oil. The USEPA official told us that this is a minor problem compared to the dripping gaskets and is probably outside USEPA's regulatory purview. According to Oak Ridge, experience has shown that PCBs cannot readily be eliminated from the cascade because they impregnate the metal and continue to contaminate fresh oil. Oak Ridge officials also stated that they do not consider the situation to be unsatisfactory because the lubricating system keeps most material inside.

In addition to PCB contamination, a February 1985 internal audit found that Portsmouth's records do not properly account for up to 15 percent of the PCB wastes generated since 1982. The audit report concluded there is no indication that Portsmouth improperly disposed of the waste but attributed the discrepancies to recordkeeping and administrative deficiencies. For example, invoice numbers were prepared but never used, and waste in partially filled drums was combined with other drums and the invoice numbers never changed. Portsmouth officials told us that actions have been taken to prevent a recurrence of this problem.

PCBs are not Portsmouth's only hazardous waste problem. About 80,000 cubic yards of lithium hydroxide, generated by Oak Ridge, is stored there in about 160,000 fiberboard containers. According to Portsmouth officials, none of the containers are in good shape, and about 3,500 may have to be replaced. Portsmouth has found lithium hydroxide in the soil and water outside the warehouse where it is stored. According to Ohio EPA, Portsmouth must either properly dispose of or reuse this waste to comply

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with federal and state Resource Conservation and Recovery Act (RCRA) regulations. Oak Ridge is now studying alternatives to correct this problem.

In addition, Ohio EPA found Portsmouth out of compliance with RCRA on March 13, 1984. The primary deficiency found was inadequate ground water monitoring around waste disposal sites.

Independent evaluation of Portsmouth's environmental monitoring

In March 1985 at DOE's request NUS Corporation, Gaithersburg, Maryland, began an assessment of Portsmouth's environmental program. It reported its findings to DOE and Portsmouth in August 1985. NUS concentrated on five program areas: (1) surface water monitoring, (2) air monitoring, (3) ground water monitoring, (4) waste, and (5) radiological assessments. NUS found that Portsmouth met DOE's requirements in only one area--radiological assessments--and was critical of Portsmouth's effectiveness in the other four areas. For example, the report noted that ground water monitoring wells were not properly located to allow for early detection of contamination nor did they provide a good basis for developing quality assessments once contamination is detected. The report offered numerous recommendations for improvements needed and stated that each problem could be resolved if Portsmouth made a concerted effort to do so. Portsmouth is taking corrective actions to resolve the problems found. Despite the problems noted, NUS concluded no health or safety problems existed either for the environment or plant workers.

WORKER HEALTH AND SAFETY

Many employees have been exposed to radioactive and hazardous substances during Portsmouth's 30 years of operation. Between 1965 and 1972 Portsmouth reported that 17 employees received radiation exposures in excess of 7.5 rem and 8 of the 17 exceeded DOE's annual internal 15-rem standard. Since 1972 Portsmouth reports show that no employee has exceeded exposure standards from radioactive substances. Portsmouth's industrial accident rate for the last 5 years has been about 50 percent of DOE-wide and related-industry rates. However, the accidents that do occur appear to be more severe than for DOE overall.

Portsmouth's worker health and safety responsibilities are carried out by its Medical, Safety, and Environmental Division that includes the Industrial Hygiene and Health Physics Department and the Safety Department. Portsmouth also has a Nuclear Criticality Safety staff responsible for preventing conditions that could result in a nuclear criticality accident.

Health physics

The primary health physics (radioactive substance) concern at Portsmouth is controlling exposures to soluble uranium. DOE

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has established standards for permissible exposures that vary depending upon the part of the body exposed. For example, maximum worker whole-body exposure to radiation must be limited to 5 rem per year; exposure to organs such as the lung to 15 rem; exposure to the bone to 30 rem; and to the body's extremities, such as the hands and feet, to 75 rem. In addition, DOE requires Portsmouth to report worker radiation exposures that result in a dose to a critical organ exceeding 50 percent of DOE's standard for that organ.

To identify the various radiological hazards, Portsmouth monitors both employees and work areas. Employee exposure levels are measured by urinalysis (for internal radiation), badges for exposure to external radiation, and in-vivo counters for radioactivity in the lungs. Work areas are continuously monitored for radiation contamination with both permanent and portable monitoring instruments.

Urinalysis

Portsmouth's industrial hygiene and health physics department supervisor considers urinalysis to be the best monitoring procedure for internal radiological exposure because most employee exposures at Portsmouth are to a soluble-type uranium that passes readily through the kidneys. Portsmouth has both a routine urinalysis program and a special program for known or suspected exposures of employees. Furthermore, an employee has the option of requesting a urinalysis at any time.

From 1955 to 1984 Portsmouth's data showed that 131,879 routine and special urine samples had been tested for radioactive substances. Fifty-seven samples showed radiation levels that, if maintained at that level for 1 year, would have exceeded DOE's radiation standard for the bone. However, soluble uranium passes readily through the kidneys and leaves little or no trace in the body. On the basis of a limited review of 6 of the 57 cases, we noted that Portsmouth had followed its procedures by reassigning these people to other jobs to avoid further exposure. Subsequent tests showed that within 3 to 21 days the radiation levels had been reduced to a level too low to measure and the employees returned to their regular work assignments.

Badges

Portsmouth used film badges to monitor external radiation to employees through December 1980--at that time it converted to the thermoluminescent dosimeter (TLD). Portsmouth's industrial hygiene and health physics department supervisor believes the TLD is more sensitive and accurate while being less labor-intensive than the film badge. This official also believes TLDs enable Portsmouth to reduce radiation exposures in accordance with its ALARA policy by identifying hot spots that can be avoided or corrected.

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Portsmouth's summary data for the 1956-1984 period show that of the 41,058 badges monitored no employee in any 1 year received an exposure in excess of DOE's annual whole-body standard of 5 rem. Portsmouth's records indicate that 19 employees had cumulative exposures in excess of 5 rem--two with slightly over 10 rem--that occurred over a 15- to 31-year period. Twelve employees (including the 2 with over 10 rem) were still working as of July 1985--8 with over 30 years of service. Table II.2 shows results for badges for the last 5 years (1980-1984), primarily representing TLD monitoring.

Table II.2: Reported Employee Whole-body Radiation Exposure at Portsmouth: 1980-1984

Year	Total employees reported[a]	No exposure	Up to 1 rem	1 to 2 rem
1980	995	386	608	1
1981	1,255	662	593	-
1982	599	335	264	-
1983	573	280	293	-
1984	880	621	259	-
Total	4,302	2,284	2,017	1

[a]Represents only employees whom Portsmouth considered to have potential for exposure.

In-vivo counter

The in-vivo counter measures the amount of radioactivity in the lungs. It did not become available for use at Portsmouth until 1965. In 1965 Portsmouth found eight employees with radiation levels above DOE's 15 rem lung standard and two with more than 7.5 rem--half the DOE standard. In 1972 Portsmouth found seven more employees with over 7.5 rem. Since 1972 no additional employees have been reported by Portsmouth as exceeding 7.5 rem. Of the 17 employees, 11 had worked in the oxide conversion facility, which was used from 1961 until 1978. As of July 1985, 9 of the 17 employees had left the company.

Of the remaining eight employees, two had been transferred to nonradiological jobs and are no longer monitored. During the 1980-1984 period, in-vivo results for the other six employees showed slight uranium in the lungs of one that, according to DOE officials, was well below acceptable standards. Portsmouth could not make an accurate determination for the other five employees because available readings were below detectable limits of the in-vivo counter.

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ALARA implementation at Portsmouth

According to its officials, Portsmouth's overall radiation safety programs use a number of safeguards to keep exposure levels within applicable DOE guidelines and as low as reasonably achievable. The safeguards include plant design features of the enrichment cascade that contain--rather than release--materials, industrial hygiene and health physics surveys of work areas to identify potential hazards, ventilation and exhaust systems to minimize airborne radioactivity, air monitoring in buildings to detect radiation levels, company-furnished protective clothing to prevent the spread of contamination, decontamination of equipment prior to performing maintenance, and respirators to reduce harmful inhalations when warranted.

Portsmouth officials state that it continually evaluates the effectiveness of its radiation safety program to ensure compliance with DOE standards and ALARA goals. The results of these assessments help Portsmouth identify problem areas for corrective action.

As of October 1985, Portsmouth did not have quantifiable ALARA goals for worker exposures. Rather Portsmouth identified those operations that could reduce worker radiation exposures and then sought ways to change its operations to reduce the exposures. Portsmouth officials stated that its ALARA program has reduced employee exposures. A March 1985 headquarters ES&H appraisal of Oak Ridge noted that Portsmouth's progress toward reducing worker exposures was difficult to measure because its stated ALARA goals could not be evaluated.

Studies of health impacts

Two non-DOE organizations--the Oak Ridge Associated Universities (ORAU) and the National Institute for Occupational Safety and Health (NIOSH)--are doing mortality studies of the effects of radiation on Portsmouth employees. Portsmouth is part of an overall ORAU study of all DOE facilities. According to the lead epidemiologist for this study, ORAU is in the process of gathering preliminary data on worker deaths at Portsmouth. However, ORAU's efforts are proceeding more slowly than expected because (1) Portsmouth provided ORAU an inaccurate roster of employees that had to be corrected and (2) ORAU is going to complete a study of another DOE facility before continuing with Portsmouth. As a result, the epidemiologist could not estimate when ORAU's study of Portsmouth would be completed. At this time ORAU has no plans to conduct a morbidity (illness) study of Portsmouth's employees.

The NIOSH study was initiated at Portsmouth as a result of a 1979 request from the Oil, Chemical, and Atomic Workers Union, which alleged that Portsmouth's employees had increased death rates from cancer. NIOSH estimates it will complete its study by the end of December 1985.

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In addition, in September 1985 an Oak Ridge task force reported its results of a study of the safety and health effects of workers handling and processing plutonium-contaminated material. The task force study included an oxide conversion facility at Portsmouth that DOE closed in 1978 because it was contaminating workers. The task force recommended that DOE and Portsmouth assess the exposures of employees who had worked in this facility while it operated.

Industrial Hygiene

Portsmouth records identify more than 500 hazardous substances at the plant. The standards Portsmouth uses for hazardous substance exposure of its employees vary depending on whether it is measuring airborne concentrations or determining amounts inhaled.

For airborne concentrations Portsmouth uses the more stringent of the standards established by the Occupational Safety and Health Administration and the American Conference of Government Industrial Hygienists. If neither of these organizations has a standard for a substance, Portsmouth attempts to identify other standards through NIOSH or a DOE laboratory. For inhaled substances Portsmouth sets worker restriction limits based on the latest toxicological data available. For example, it uses the National Safety Council's standard for lead and Casarett and Doull's Toxicology for nickel and fluoride. Portsmouth uses these standards as its worker restriction limits.

Portsmouth monitors its employees' exposures through personal monitoring (such as urinalysis) and area monitoring. Area monitoring involves using various instruments to measure the concentration of specific gases to ensure that various engineering controls are working. Portsmouth officials told us they keep up to date on industrial hygiene equipment through conferences, trade shows, and trade journals.

Our review of urinalysis records showed that Portsmouth analyzed about 32,000 samples between 1981 and 1984 for both radioactive and nonradioactive substances. According to Portsmouth officials, analysis of urine specimens is very selective and is based on the type of substances to which employees may be exposed. Of the samples tested for nonradioactive substances, 79 samples indicated worker exposure to either fluoride, nickel, lead, or chromium. Twelve samples showed readings higher than the worker restriction limits. These 12 employees were moved to other work locations until their exposure readings were below acceptable levels.

Occupational safety

Portsmouth's occupational safety program (administered by its Industrial Safety Department) inspects equipment, materials,

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and facilities and monitors plant operations and workplaces. Oak Ridge appraisals since 1980 have rated the occupational safety program as excellent, but Oak Ridge did make recommendations for further improvements. In addition, occupational safety inspections identified various employee safety hazards. Although Oak Ridge did not believe the deficiencies posed an imminent danger to workers, Portsmouth officials told us they initiated actions within a few days to correct the deficiencies found.

Portsmouth reports individual lost workday cases to Oak Ridge on a monthly and quarterly basis and compiles monthly reports by departments of cases involving time away from work for its own use. It does not, however, compile an annual lost workday rate. Therefore, we calculated this information on the basis of Portsmouth's data.

We found that, while Portsmouth has considerably fewer lost workday cases than DOE-wide rates, the injuries that occurred resulted in employees' losing more workdays. For example, Portsmouth's injury reports for the 3-month periods January-March 1980 and January-March 1983 showed that 1 employee lost 314 workdays because of an oil fire that burned over 40 percent of his body and another lost 127 days because of an on-site vehicular accident. Other Portsmouth employees injured during these same periods had an average of 22 lost workdays. Portsmouth's 1980-1984 lost workday case and lost workdays as compared with DOE-wide and the chemical and allied products industry rates are shown in table II.3.

Table II.3: Comparison of Portsmouth's Reported Accident Statistics With DOE and Industry Rates: 1980-1984

	Lost workday case rate			Lost workdays rate		
Year	Portsmouth	DOE-wide	Chemical and allied products industry	Portsmouth	DOE-wide	Chemical and allied products industry
1980	0.53	1.1	1.14	35.8	18.1	23.0
1981	.55	1.0	1.32	29.8	14.9	26.0
1982	.48	1.0	1.06	17.2	13.5	21.0
1983	.40	1.1	.95	20.9	20.3	20.0
1984	.30	1.1	.91	10.5	16.7	17.0

In addition, during the last 5 years one construction employee died while working at Portsmouth. Therefore, the fatality is not included in the data in table II.3. A DOE investigation report concluded that safety violations caused the death and provided recommendations to prevent a recurrence.

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NUCLEAR CRITICALITY SAFETY

Under the proper conditions, fissionable material can develop a self-sustaining nuclear chain reaction and the subsequent release of intense neutron and gamma radiation to the environment. Exposure to large amounts of radiation can kill a person in a few days. The highly enriched uranium produced at Portsmouth can generate such a chain reaction. DOE directives require--and Portsmouth maintains--a nuclear criticality safety program that, if properly implemented, will prevent conditions that could result in a nuclear accident.

Portsmouth has five people responsible for its nuclear criticality safety program. The staff, consisting of nuclear engineers and physicists, develops and approves engineering and administrative controls to ensure that procedures, practices, and methods for handling and storing of nuclear materials and wastes prevent a nuclear criticality accident.

The plant's operating personnel are required to perform work consistent with all engineering and administrative controls. For example, supervisors of the uranium handling facilities are responsible for ensuring that personnel are properly trained in these controls and that all nuclear criticality safety requirements are met. Portsmouth's policy also requires supervisors to perform monthly surveys to identify deviations from requirements and corrective actions needed.

Implementation of Portsmouth's nuclear criticality safety program directly affects the Production and Technical Divisions. Both evaluate their operations annually. Portsmouth's nuclear criticality safety staff performs monthly reviews; its internal audit staff performs annual evaluations. In addition, Oak Ridge conducts annual appraisals of Portsmouth's nuclear criticality safety program and a team of consultants reviews it every 3 years.

Although there has never been a nuclear criticality at Portsmouth, in each year from 1982 to 1984, Portsmouth had an incident that, if it had continued, might have resulted in a criticality accident. DOE ranks the severity of incidents by six categories--six being the most severe. The 1982-1984 incidents were given ratings of four and were attributed to operator error that resulted in an open valve that controls the flow of material in the production process, malfunction of a probe used to determine the amount of recoverable uranium in one part of the plant, and water leaks in a uranium storage vault.

Portsmouth's reports showed that it took corrective actions on the problems found. It revised its procedures to include more frequent inspections of the valve, changed the probe and added another one as a safety measure, and installed drip pans to catch the water. On the average Portsmouth completed these actions within 9 months of discovering the problem. Despite the

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incidents reported, Oak Ridge rated Portsmouth's criticality safety program as excellent for the latest three appraisals. Oak Ridge characterized Portsmouth's investigations of the incidents and its recommendations for corrective actions as high quality.

Despite the excellent ratings, Oak Ridge has recommended some corrective actions for the criticality safety program. For example, the 1984 Oak Ridge report criticized Portsmouth for allowing cracks and potholes to remain in the floor of a facility for 5 years--the facility is used to store containers of uranium-contaminated solutions. Oak Ridge believed that spills or leaks could have resulted in a sufficient accumulation of solution in the cracks and potholes to create a condition conducive to nuclear criticality. Repair funds were originally available in fiscal year 1980. However, the floor was not repaired because it would have hindered the cascade improvement and upgrade program that was not completed until 1983. The floor was repaired in 1984 at a cost of about $20,000 after a 1984 Oak Ridge evaluation recommended priority attention.

UNION COMMENTS

The president of the local Oil, Chemical, and Atomic Workers Union--the union representing about 1,000 of Portsmouth's employees--and a legal consultant to the union told us that problems exist at Portsmouth that affect worker health and safety. For example, they told us that Portsmouth's worker exposures and occupational injuries are understated and employees are merely part of an experiment to prove that radiation is safe. These individuals did not, however, provide documentation to support these allegations. They also stated that Portsmouth's urine sampling procedures are faulty because samples are taken at the beginning rather than end of the week. We found that Portsmouth's procedures stipulate that employees should submit urine samples at the end of the workweek.

In addition, the union representatives told us they were not satisfied with Oak Ridge's response to complaints sent under the DOE complaint system. Our review of complaint files from January 1980 through December 1984 showed that Oak Ridge responded to complaintants by letter and referred some to Portsmouth for resolution rather than conducting an independent DOE investigation.

HISTORICAL PROBLEMS

Portsmouth has been burying low-level radioactive waste and hazardous substances on-site and disposing of liquids in a waste treatment pond since 1955. It has, however, drilled 21 on-site wells around the plant to monitor for the migration (movement) of radioactive and hazardous substances.

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APPENDIX II

In 1981 Portsmouth found uranium contamination and in 1984 hazardous substances in wells near the burial site. Although the uranium concentrations were within DOE's surface water guides, the concentrations of hazardous substances ranged from 160 to 2,130 parts per billion compared with USEPA's drinking water limit of 15 parts per billion. In addition, in 1984 Portsmouth found significant quantities of hazardous substances in a well located near the holding pond and in 1985 found radioactive substances in the well. This well was drilled in late 1984. While the radioactive contamination was within DOE's surface water guide, samples taken from it show hazardous substance contamination ranging from 175,000 to 291,000 parts per billion compared to USEPA's limit of 15 parts per billion.

While samples from wells in only two plant areas have shown contamination, Portsmouth does not know if this is the full extent of the problem nor whether off-site contamination has occurred. Portsmouth in 1985 contracted for a study to identify the extent of uranium and hazardous substances migration from the burial site and holding pond and is drilling 27 new ground water monitoring wells at these locations. According to officials, Portsmouth expects to complete drilling these wells and take and analyze samples by November 30, 1985.

AWARD FEE

To encourage Portsmouth to achieve high-quality performance, DOE uses the cost-plus-award-fee contract. DOE's structure for Portsmouth's award fee determination includes performance evaluation committees, an award fee board, and Oak Ridge's manager. The committees assess Portsmouth's performance using preestablished performance objectives, criteria, and standards. The award fee board reviews the committees' findings and recommends the fee amount to the Oak Ridge manager. Ultimately, Oak Ridge's manager determines how much, if any, fee should be awarded.

The president of Goodyear Atomic stated that prior to 1985 there was no particular discussion of ES&H factors for purposes of determining the award fee. Even now, the president stated he is not aware of the weight Oak Ridge gives ES&H factors in determining the fee. Oak Ridge and Portsmouth agree to broad categorical goals prior to each contract period. While these goals include ES&H activities, the weight ES&H activities carry in the award fee process is not set. Rather Oak Ridge sets the weight at the end of the award fee process. It was the president's perception that Oak Ridge does not want Portsmouth to know the weight ES&H activities received because Oak Ridge would then lose flexibility to change the weight applied to ES&H and other factors at the end of the award fee process. In recent years Portsmouth's award fee had been increasing steadily--from 62.9 percent of the available fee in fiscal year 1981 to 70.9 percent in fiscal year 1984.

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For the first half of fiscal year 1985, Portsmouth received 62.5 percent of the available fee and $400,000 less than the award fee board recommended. Oak Ridge identified three broad performance areas for Portsmouth--management and administration, cost control, and production and operations--and assigned weighting factors of 30, 30, and 40 percent, respectively. ES&H programs were included in the management and administration and production and operation areas, but their assigned weights were not identified to Portsmouth.

In reducing the fee, Oak Ridge's manager based his decision in large part on the need for Portsmouth to give greater emphasis to ES&H activities and identified several ES&H deficiencies--but did not specify the amount applicable to these deficiencies. Specifically, Oak Ridge's manager concluded that Portsmouth needs to (1) improve employee confidence in its commitment to resolve safety and health problems, (2) establish programs to aggressively identify environmental problems, and (3) improve communications of and sensitivity to incidents.

RELEASE DATA

In 1981 and 1983, we recommended that DOE obtain independent data to verify the data reported by its contractors.[2] Until recently Portsmouth did the only monitoring of radioactive releases from the plant. Neither Ohio nor DOE independently sampled or monitored environmental radioactive releases in and around the plant. However, in 1985 DOE entered into a cooperative agreement with the Ohio Department of Health to test upon request off-site drinking water supplies. In addition, Portsmouth has an agreement with the Ohio Department of Health to jointly test 20 percent of the water samples taken by it. As of October 31, 1985, six samples had been collected, and one had been provided to Portsmouth for testing.

APPRAISALS

Oak Ridge conducts (1) appraisals of Portsmouth's ES&H programs and (2) inspections to ensure safety of plant operations. Although DOE requires that safety inspections be done annually, neither DOE nor Oak Ridge has criteria for the frequency of appraisals. DOE's policy states that frequency of appraisals "shall be based on the nature and level of risk involved and commensurate with the Departmental policy of comparability and equivalence with similar regulatory and insurance programs." In the November 1983 report cited above, we recommended that appraisals be conducted annually.

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[2](EMD-81-108, July 27, 1981) and (RCED-84-50, Nov. 30, 1983).

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Our review of Oak Ridge's 1980-1984 reports disclosed that, while Oak Ridge has performed appraisals of Portsmouth's ES&H programs, in some cases the appraisals were not done for as long as 2 years. In addition, Oak Ridge has discontinued independent environmental reviews; its staff now accompanies Ohio EPA inspectors. However, Oak Ridge does not inspect for environmental radiological releases during these shared inspections. According to DOE officials, while in some cases formal on-site audits have not been conducted, site visits, inspections, and communications have provided DOE information on Portsmouth's ES&H programs. Oak Ridge's appraisals and inspections for the last 5 years are shown in table II.4.

Table II.4: Summary of Appraisals

	Appraisals of				
Year reviewed	Safety	Health physics	Industrial hygiene	Environment	OSHA-type inspections
1980	x[a]			x[b]	x
1981	x	x[c]	x[c]	x	x
1982	x	x	x	x[d]	x
1983		x	x		x
1984	x[e]	x			

[a]Appraisal covers the period from May 1978-August 1980.

[b]Appraisal covers the period from May 1978-July 1980.

[c]Appraisal covers the 2-year period from March 1979-March 1981.

[d]Appraisals discontinued after 1982. Instead, Oak Ridge staff accompanied Ohio EPA inspectors on inspections.

[e]Appraisal covers the period from October 1982-August 1984.

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PROGRAMS TO PROTECT THE ENVIRONMENT AND WORKER HEALTH AND SAFETY AT MOUND

Monsanto Research Corporation, a subsidiary of the Monsanto Company, operates Mound in Miamisburg, Ohio, near Dayton. Mound covers 306 acres and employs about 2,700 people. Mound was established in 1946 as an outgrowth of the Manhattan Project. Currently, Mound is a research, development, and production facility performing work in support of DOE's weapons, aerospace, and medical programs. Much of Mound's operations are classified. Monsanto's Operational Safety Group, with a staff of 148 people, is responsible for ES&H programs.

Mound uses two radioactive elements in its production and assembly activities. Plutonium, a highly radioactive toxic substance, arrives at Mound in a sealed capsule and remains encapsulated throughout all production operations. The other is tritium, a low-toxicity radioactive hydrogen isotope, that is hazardous if absorbed. Mound processes tritium in a series of double- and triple-contained pipes and tanks.

DOE's Albuquerque Operations Office supervises operations at Mound. Albuquerque's ES&H Division has 37 people to oversee both radiation-related and hazardous substance programs at 10 facilities under Albuquerque's jurisdiction. Albuquerque also has a staff of about 25 people at Mound, including one full-time person responsible for monitoring Mound's ES&H activities and ALARA program, evaluating ES&H activities for contract award-fee purposes, and providing liaison between Mound and Albuquerque ES&H staff.

Albuquerque monitors Mound's compliance with DOE's ES&H requirements principally through appraisals. Albuquerque officials told us they perform annual appraisals of selected elements of Mound's ES&H program areas (such as health physics and industrial hygiene) each year and appraise every program element at least once every 3 years.

ENVIRONMENTAL PROTECTION: STATUS AND ISSUES

Mound's reported environmental releases have been within applicable federal standards over the last 5 years. Mound has a program to monitor the primary pathways--air, water, vegetation, and sediment--of potential radioactive contamination. Mound's laboratory analyzes air and water samples to detect plutonium and tritium releases as well as numerous hazardous compounds. Mound also generates radioactive and hazardous wastes that are stored pending off-site disposal.

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Radioactive environmental releases

The goal of Mound's environmental control program is to maintain its radioactive emissions at the lowest practical levels within existing environmental standards including DOE orders and guidelines and USEPA's drinking water standards for tritium. Mound monitors air and water quality at numerous locations on site and up to 30 miles from the plant. It annually reports the results to federal, state, and local agencies and the public.

Mound initiated a program in the early 1970's to reduce radioactive emissions of tritium and plutonium to levels below DOE's guidelines. In addition, each year Mound sets specific exposure limits that are more stringent than DOE's standards of 5 rem for the whole body. For example, in 1985 Mound's ALARA goal was 1.3 rem for whole-body exposures. Further, Mound sets outstanding performance goals for its managers that are even lower than the plant's ALARA goals--in 1985 the whole-body exposure goal was 0.8 rem.

Air releases

DOE regulated Mound's radioactive airborne releases until February 1985 when USEPA assumed regulatory responsibility. To measure compliance with both DOE and USEPA standards, Mound has on- and off-site air monitors. Mound located these monitors on the basis of historical meteorological data from the local area. Its air monitoring network consists of three systems:

--Fifteen continuously operating stack monitors are located in buildings where radioactive material is handled. These monitors are equipped with automatic alarm systems that are designed to go off if radioactive emissions increase above a certain level.

--Five samplers near the plant perimeter are designed to detect releases leaving the site.

--Fifteen off-site air samplers (DOE believes 5 are sufficient) at various locations up to 30 miles from the plant.

According to its annual environmental reports, Mound's radioactive air emissions over the last 5 years have been less than 1 percent of the DOE standard and within USEPA's February 1985 standard with which Mound must now comply. In addition, Mound has not exceeded its ALARA goals for airborne releases in the last 5 years.

Water releases

DOE and USEPA share regulatory responsibility for radioactive water releases. DOE regulates releases from its

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facilities; USEPA regulates tritium concentrations in drinking water. Mound's water sampling network consists of 3 on-site and 29 off-site locations. The off-site locations include various rivers, ponds, and wells up to 30 miles from the plant. According to Mound officials, river sampling locations were selected on the basis of USEPA guidelines; the contractor selected other sampling stations to provide coverage of the surrounding area. According to DOE officials, Mound's sampling network and procedures comply with DOE's water monitoring guide.

Over the last 5 years, Mound's reported liquid effluent releases of plutonium and tritium have been less than 1 percent of DOE's guide for rivers and ponds and below Mound's ALARA goals. However, prior actions at the plant have resulted in tritium contamination of a drinking water aquifer. This problem is discussed later.

Dose assessment of off-site population

Mound annually estimates the maximum radiation exposure (referred to as a dose) that an off-site individual could receive from its air and water releases. Mound's estimated maximum dose is compared to DOE's standard for whole-body exposure (0.5 rem) and for exposure to the most critical organ (1.5 rem to the lung). Mound's estimated doses have been less than 1 percent of the DOE standards over the last 5 years. The details are shown in table III.1.

Table III.1: Comparison of Whole-body and Critical Organ Dose to DOE Standard for the Maximally Exposed Individual: 1980-1984

	Whole body		Lung[a]	
Year	Dose (rem/year)	Percent of standard	Dose (rem/year)[b]	Percent of standard
1980	0.0021	.42	0.0004	.026
1981	.0014	.28	.0020	.133
1982	.0012	.24	.0001	.007
1983	.0008	.16	.0001	.007
1984	.0007	.14	.0002	.013

[a]The most critical organ will vary depending on the type of radiation released from the facility.

[b]For the 5-year period, lung doses were calculated using the old International Commission on Radiological Protection methodology.

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Nonradioactive emissions

Mound utilizes numerous nonradioactive substances such as sulfur, cyanide, copper, and chlorine that could be released to the environment. The Ohio EPA regulates and issues permits for hazardous substances emitted from industrial facilities in the state. To fulfill its air emission oversight responsibilities in the area around Mound, Ohio EPA contracts with the Regional Air Pollution Control Agency (RAPCA). Water releases are controlled by Ohio EPA through site-specific permits.

Air releases

RAPCA is responsible to Ohio EPA for monitoring local air quality and issuing emission permits for industrial air emissions. RAPCA maintains a network of 26 air samplers to detect hazardous air pollutants like carbon monoxide, sulfur, and particulates.

According to Mound officials, its actions to control air releases from the plant exceed its requirements. For example, on the basis of site inspection and operation levels, RAPCA determined that Mound's emissions are negligible and no permits are required. Nevertheless, Mound has filed--but not yet received--permit applications for its paint, carpentry, machine, and grinding shops; boilers; and oil burner. The state has granted Mound interim operating authority pending issuance of permits for these plant areas. Similarly, while not required to monitor emissions, Mound officials told us they analyze particulate emission samples weekly and estimate levels of other nonradioactive emissions on the basis of a USEPA model as a precautionary measure. These results have been within Ohio EPA air pollution regulations for the last 5 years.

Water releases

Mound's liquid effluents are regulated by Ohio EPA through a National Pollutant Discharge Elimination System (NPDES) permit. Mound's original NPDES permit was issued in 1975 and renewed in 1980 by the USEPA. In 1983 Ohio EPA received authority from USEPA to regulate federal facilities and has recently approved Mound's 1985 permit application. The permits specify discharge levels for treated effluents as they leave the plant and require Mound to test for specific substances at four on-site locations prior to discharging the effluents to a river adjacent to the plant.[1]

In the last 5 years Mound has exceeded its permit levels many times because of mud (suspended solids) in its effluents after a heavy rain. For example, in 1984 Mound analyzed over

[1]The substances include sewage, suspended solids (mud in the water), acidity, grease, oil, chlorine, nickel, and cyanide.

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1,460 samples and exceeded its permit 58 times--primarily due to mud. Despite the persistence of the problem, Ohio EPA does not believe the mud has had an adverse impact on the environment since Mound discharges its water into a large river and the mud is quickly diluted and transported downstream.

After an evaluation of the site, Ohio EPA determined that the original permit limits for suspended solids were unrealistic during heavy rainfall and revised Mound's permit to allow for limited increases during heavy rainfall. In addition, Mound has improved its on-site containment system to decrease the level of suspended solids discharged to the river. Mound officials believe its actions will bring the amount of mud discharged within state limits. Aside from this problem, Ohio EPA officials told us they are satisfied with Mound's NPDES compliance for the last 5 years.

Waste management

Mound generates radioactive and hazardous waste and waste mixed with both radioactive and hazardous substances (mixed waste) from its operations. Except for the mixed waste, all waste is processed and sent off site for disposal.

Mound's radioactive waste is sent to various DOE disposal facilities around the country. The majority of Mound's plutonium and tritium waste is sent to Nevada; some plutonium is sent to Idaho. In addition, one or two drums per year of classified waste are sent to South Carolina.

Mound also generates both liquid and solid hazardous waste that is sent to an off-site commercial facility for disposal. These wastes include organic solvents, oil, paint, sewage, and polychlorinated biphenyls (PCB). Mound is required to package, mark, inspect, and ship PCB waste in accordance with Toxic Substances Control Act requirements and is required to handle other hazardous waste according to provisions of the Resource Conservation and Recovery Act (RCRA).

USEPA granted Mound interim status--the first phase of the two-phase RCRA permitting process--in 1982. Ohio EPA also has authority to grant Mound interim status, but it does not have authority to issue RCRA permits. Although Ohio EPA expects to obtain permitting authority shortly, it does not plan to issue Mound a RCRA permit until DOE and USEPA resolve their regulatory dispute over mixed waste. Pending resolution of the regulatory issue, Mound cannot dispose of its mixed waste. Instead, Mound, as of August 1985, stored about 150 drums on site.

WORKER HEALTH AND SAFETY

As a result of industrial accidents between 1960 and 1979, 17 employees received plutonium doses that exceeded DOE's standards. Since 1973, however, Mound has reduced worker

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APPENDIX III

whole-body radiation exposure to one quarter of the DOE standard. While a 1984 Albuquerque appraisal of Mound's industrial hygiene activities found that written procedures and operational records were below DOE's requirements, Albuquerque and Mound officials told us the problems represented no direct health threat. Finally, Mound's reported safety statistics have been among the best in DOE over the last 5 years.

Monsanto's Operational Safety Group is responsible for occupational safety and health programs at Mound. Two units within this group have primary responsibility for the three major worker protection programs:

--Health physics unit is responsible solely for radiation safety and monitoring of plant operations.

--Safety unit is responsible for nonradiation-related industrial hygiene and worker safety activities.

Health physics

Mound has a large-scale health physics program that includes both personnel and workplace monitoring to detect and reduce overexposures to radioactive substances. To measure workers' external whole-body exposures, Mound uses thermoluminescent dosimeters (TLD). Previously Mound used film badges but stopped using them to measure gamma radiation in 1968 and for neutron radiation in 1973. Mound's health physics official told us that for gamma radiation the TLD is more accurate and more sensitive than the film badge and film badges often showed a wide variety of readings from the same exposure.

To monitor worker internal exposures, Mound uses urinalysis and nose wipes. Urinalysis measures internal deposits of plutonium and tritium, and nose wipes indicate possible particulate inhalation. In addition, an on-site whole-body counter provides routine lung scans. Mound also provides some employees with personal protective devices such as laboratory coats, shoe covers, respirators, plastic clothing, and bubble suits to reduce worker exposure to radiation hazards and minimize its spread in the plant.

Similarly, Mound uses a number of methods to reduce and detect radiation in the workplace. Mound's radioactive operations are conducted behind double and triple containment using glove boxes and remote control devices for operations and maintenance. In addition, radiation monitoring instruments located throughout the plant detect radiation resulting from leaks or accidents. Monitors display the results at specific locations and relay the data to centralized observation points. In addition, Mound's health physics staff use portable air samplers to assay specific work areas and take surface contamination samples for laboratory analyses.

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DOE requires Mound to calculate worker whole-body exposures and report annually. Mound's whole-body exposure statistics for the last 5 years are shown in table III.2.

Table III.2: Reported Employee Whole-body Radiation Exposures at Mound: 1980-1984

Year	Total employees reported	No exposure	Up to 1 rem	1 to 2 rem
1980	1,565	613	951	1
1981	1,567	336	1,228	3
1982	1,852	373	1,479	-
1983	1,918	182	1,736	-
1984	2,050	52	1,998	-
Total	8,952	1,556	7,392	4

DOE also requires Mound to separately report worker radiation exposures that result in a dose to a particular organ or tissue exceeding 50 percent of the DOE standard for that organ. Mound uses urinalysis and a whole-body counter to make this determination. Since 1980 Mound has reported six people with internal exposures exceeding 50 percent of DOE's standard. These employees inhaled plutonium dust prior to 1978. However, once in the body, plutonium tends to stay. This situation is discussed later.

In addition to DOE's whole-body and internal exposure standards, Mound's ALARA program establishes exposure goals that are significantly lower than DOE's whole-body exposure standard of 5 rem. As early as 1973, Mound's ALARA goal was to maintain whole-body exposures at 2.5 rem (one half the DOE-required level). Since 1978 the goal has been reduced each year. Mound also sets even more restrictive limits as outstanding performance goals for managers responsible for exposure control and nuclear operations. For example, Mound's 1985 ALARA goal for plutonium was 1.3 rem, and the outstanding performance goal was 0.80 rem. For the past 5 years, Mound has met both its ALARA and outstanding performance goals.

Industrial hygiene

DOE Order 5480.10--Contractor Industrial Hygiene Programs--establishes requirements for contractors to identify, evaluate, and control nonradiological hazards in the workplace. These orders establish exposure standards for chemicals on the basis of applicable federal standards and require contractors to have a system to ensure the standards are met. The orders do not tell the contractors how to set up an industrial hygiene program, but they do require that all procedures be in writing

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APPENDIX III

and be updated to reflect changes in the substances and procedures used in the workplace. In addition, the contractor is required to document all industrial hygiene accidents and activities to ensure compliance with standards.

To keep up with changes in the work environment, Mound officials told us they annually conduct a hazard assessment of various work areas within the plant. It also maintains a hazardous chemical inventory, inspects exhaust hoods and vents annually, and provides respirators to employees. In addition, Mound has instituted a noise reduction program and takes chemical samples throughout the plant to monitor exposures to chemicals.

In a 1984 appraisal Albuquerque found that Mound did not comply with documentation requirements set out in DOE's orders. DOE found that for at least 18 months documentation of procedures and industrial hygiene operations had been neglected because of personnel shortages caused by attrition. Both DOE and Mound officials agree that no serious worker health violations resulted from these problems. DOE officials stated that if the problems had continued Mound may not have had either the information needed to identify new hazards or the procedures in place to deal with them. On the basis of DOE's recommendation, Mound undertook a 2-year program to upgrade its recordkeeping practices. A July 1985 appraisal by Albuquerque found that Mound was making progress to correct the deficiencies found.

Worker safety

Day-to-day safety operations and administration are handled by Mound's safety staff of 24 people. The focal point of its safety activities is an Executive Safety Committee, chaired by Mound's plant director. The committee establishes and oversees a network of 11 other committees designed to deal with specific aspects of the plant's overall safety.

Mound's safety statistics have consistently been better than DOE-wide and National Safety Council averages. Mound's 1980-1984 reported accident statistics for two measures of worker safety are shown in table III.3.

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Table III.3: Comparison of Mound's Reported Accident Statistics With DOE and Industry Rates: 1980-1984

	Lost workday case rate			Lost workdays rate		
Year	Mound	DOE-wide	Chemical and allied products industry	Mound	DOE-wide	Chemical and allied products industry
1980	0.0	1.1	1.14	0.0	18.1	23.0
1981	.2	1.0	1.32	5.2	14.9	26.0
1982	.2	1.0	1.06	2.5	13.5	21.0
1983	.3	1.1	.95	6.1	20.3	20.0
1984	.4	1.1	.91	7.8	16.7	17.0

Both DOE and Monsanto Corporate headquarters perform periodic appraisals of Mound's safety program and compliance with OSHA standards. DOE performs both program performance and management appraisals and periodic appraisals of both Mound and subcontractor OSHA activities. Monsanto headquarters annually conducts safety and property protection surveys that, according to officials, cover all aspects of program management and performance. While both DOE's and Monsanto's appraisals frequently contain recommendations for correcting specific problems found, their assessments of Mound's overall safety program are high.

Union comments

Both the present and past union presidents focused their comments on Mound's efforts to protect worker health and safety. In this regard, they told us that Mound has excellent worker health and safety programs. They told us the programs reflected Monsanto's concern with worker safety and cited the following indicators as supporting their position.

--Both a union grievance procedure and a DOE suggestion/complaint system are available to Mound workers. The DOE system has never been used, and only a few minor safety-related union grievances have been filed.

--Under its contract the union can call an annual meeting with Mound management to discuss safety issues--such a meeting has never been called.

--The union does not have a safety committee or maintain records on safety-related problems.

HISTORICAL PROBLEMS

Past operations with plutonium have caused both employee exposures and environmental contamination; past tritium

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operations have contaminated a drinking water aquifer. DOE's Albuquerque office has evaluated the impact of Mound's radioactive releases as part of an environmental study.

Past plutonium operations

Between 1960 and 1979 Mound used a powder form of plutonium oxide. As a result of industrial accidents during this period, 17 employees received plutonium doses exceeding DOE's standard--the highest accumulated dose is estimated to be 5 times DOE's standard. All 17 employees continue to have plutonium in their bodies, but 10 no longer work at Mound.

Six of the remaining seven employees subsequently developed internal exposures in excess of 50 percent of DOE's standard because once in the blood stream plutonium is carried throughout the body and settles in the bone and liver. All internal deposits of plutonium can remain many years after the initial exposure. Mound continues to monitor and report the seven employees to DOE, if necessary.

In addition, during the time Mound used plutonium oxide, highly contaminated waste was transferred to a waste-processing facility through underground pipes. In 1969 a waste pipeline ruptured, contaminating the adjacent area with high levels of plutonium. Mound cleaned the area immediately but 5 years later found higher-than-expected plutonium levels in the sediment of an abandoned off-site canal and area surrounding the canal. After an investigation, Mound determined that these deposits resulted from the 1969 pipeline rupture.

According to Mound officials, the plutonium released to the environment did not represent an immediate health hazard to the surrounding community. The Ohio Department of Health, Ohio EPA, and an independent panel of experts convened to study the problem, concurred in this conclusion. They recommended that Mound continue monitoring the situation for future potential hazards. In response to these concerns, Mound in 1976 discontinued using and removed the underground waste transfer lines and began to periodically monitor the site and nearby water supplies for plutonium contamination. According to Mound officials, the plutonium would present an immediate hazard to the community only if, as part of a local construction project, it were dug up, allowed to dry, and then became suspended in the air where it could be inhaled. No such projects are planned for that area; the City of Miamisburg has agreed to notify Mound if it plans to develop the land in the future.

Ground water is contaminated with tritium

Mound has used tritium in various plant operations since 1958. Between 1959 and 1969, Mound released large quantities of tritium to the air--about 364,000 curies in 1 year alone.

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Further, significant amounts of tritium-contaminated water have been produced, then diluted to meet DOE concentration guides, and ultimately discharged to a nearby river.

In 1970 Mound implemented an ALARA-type program and took actions to reduce its air emissions and water releases such as installing a tritium stack reclaimer and building a liquid effluent holding pond. At that time Mound found--through its well monitoring program--tritium contamination in a local drinking water aquifer. Until 1976, however, the tritium concentrations were below DOE's standards, and no remedial actions were taken.

In 1976 the USEPA assumed regulatory authority for tritium in drinking water and issued standards that were lower than DOE's by a factor of 50. As a result, the tritium concentrations in the aquifer were significantly higher than the new standard. In order to meet USEPA's standard, Mound hired a consultant to determine the extent of tritium contamination in the aquifer. In 1976 the consultant found that operations at Mound prior to 1970 had caused the contamination. Although the consultant could not quantify the exact amount or cause of tritium in the aquifer, several possible sources of the contamination were identified:

--tritium released through normal plant operations prior to 1970,

--highly-contaminated soil around three tritium-handling buildings,

--tritium contaminated soil in a former on-site dump,

--airborne tritium brought back to the ground by rain, and

--unplanned tritium releases to sanitary and storm sewer lines and leaks from underground waste transfer lines.

To comply with USEPA's standards for tritium, Mound in 1976 began to pump water from one off-site and one on-site well (the water pumped out goes into the Great Miami River). This lowered the water level in the aquifer and caused more river water to flow into it thereby diluting the tritium. In addition, Mound replaced the old dump with a lined sanitary landfill and discontinued using the underground waste transfer lines. By September 1978, the level of tritium in the aquifer met USEPA's 1976 standards.

While DOE and Mound officials told us that the amount of tritium in the aquifer has been in compliance with applicable standards, Mound does not know how long dilution activities will continue. However, since 1976, its records show that the frequency of pumping operations have fluctuated but generally decreased. For example, in 1976 Mound pumped for 63 days, in

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1981 302 days, and through October 1985, 42 days. Pumping frequency is related to the amount of rainfall during the year. DOE does not know the full extent of the contamination, the corrective actions needed to fully resolve the issue, or the long-term health consequences.

Albuquerque officials told us that Mound needs to determine the extent of the tritium contamination problem. In 1984 Albuquerque initiated a program, the Comprehensive Environmental Assessment and Response Program (CEARP), to evaluate operations at sites within its jurisdiction that had or could have an adverse impact on the environment. The CEARP recommended that Mound improve its water monitoring program to ensure that all possible sources of contamination are identified. Albuquerque officials also told us that Mound needs to better understand the movement and flow of ground water in the vicinity of the plant. According to Mound officials, additional actions to determine the movement and flow of water will be done in connection with Albuquerque's CEARP program.

AWARD FEE HAS BEEN REDUCED BECAUSE OF ES&H PERFORMANCE

Since 1978 Monsanto has operated Mound under a cost-plus-award-fee contract that includes an award fee provision when its performance meets certain criteria established before each contract period. DOE's structure for Mound's award fee determination includes performance evaluation committees, an award fee board, and Albuquerque's manager. The committees assess Mound's performance using preestablished performance criteria. The award fee board reviews the committees' findings and recommends a fee amount to Albuquerque's manager. Ultimately the manager determines the amount of the fee, if any, to be awarded. Every 6 months Albuquerque assesses Monsanto's performance to determine if a fee is warranted. Beginning in 1983 Albuquerque and Mound not only agreed to categorical criteria prior to each contract period but also agreed to specific ES&H performance criteria. Currently ES&H-related performance accounts for 10 percent of the award fee.

Prior to 1983 ES&H performance was not separated from other performance goals; it was included in the general management area. This area accounted for 20 percent of the total fee with no prior indication of the weights given to ES&H activities. Since 1983 Albuquerque segregated industrial safety as a performance goal worth 5 percent of the overall award fee for every period except the second half of fiscal year 1984 and 1985 when health protection was substituted as a result of deficiencies found in Mound's industrial hygiene program (part of the health protection program). In the second half of fiscal year 1984, Albuquerque also added environmental protection as a performance goal worth 5 percent of the total fee. As a result of the unsatisfactory appraisal report for industrial hygiene in 1984, Mound's contract award fee was reduced by over $50,000.

CONTRACTOR-REPORTED RADIATION DATA

Neither DOE nor the state independently monitors or verifies radioactive environmental release data reported by Mound. We previously recommended that independent monitoring and verification of contractor-reported data could help ensure their accuracy.[2] However, Albuquerque has not implemented this recommendation for Mound. It continues to rely on Mound to accurately measure, analyze, and report evironmental release data. According to Albuquerque officials, Mound has a quality assurance program to check the accuracy of radioactive air and water samples analyzed by its laboratory; and therefore, they do not see a need to independently monitor or verify Mound's release data. However, both USEPA and Ohio EPA officials believe there should be a system that ensures that the release data reported represented the amount actually released.

Mound officials told us that they do not tolerate misrepresentation of information and would (and actually have) discharged employees for falsifying environmental release or worker exposure data. However, they did state that self-monitoring with appropriate verification by regulatory agencies is the cornerstone of environmental regulations.

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[2](EMD-81-108, July 27, 1981) and (RCED-84-50, Nov. 30, 1983).

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